NATIONAL
ELECTRIC LIGHT
ASSOCIATION.

Tenth and Eleventh Convention,
Niagara Falls and Kansas City.

PROCEEDINGS

OF THE

NATIONAL ELECTRIC LIGHT ASSOCIATION,

AT ITS

TENTH CONVENTION.

Semi-Annual Meeting,

HELD IN THE

CASINO, AT NIAGARA FALLS, N. Y.,

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Turnbull, George R., Treasurer	Butler Hard Rubber Co., 33 Mercer Street, New York.
Walker, D. F	Salt Lake City, Utah.
Warden, Henry	Germantown Junction, Philadelphia, Pa.
Waterhouse, Frank G.	Electrician. Pittsburgh, Pa.
Weeks, E. R., Gen. Mgr.	Kansas City Electric Light Co., Edison Electric Light Co., Kansas City, Mo.
Wells, E. H., Gen. Mgr. & Treas.	Keystone Construction Co. 95 Fifth Ave., Pittsburgh, Pa.
Wilkins, E. W.	Partrick & Carter, 114 S. 2nd St., Philadelphia, Pa.
Winchester, R. C.	Holyoke Water Power Co., Holyoke, Mass.
Wilkins, F. H.	Western Electric Co. 70 Trinity Place, New York City.
Whipple, Fred H.	Detroit, Mich.
Wright, J. J., Manager	Toronto Electric Light Co., Toronto, Canada.
Worthington, Geo., Editor	Electrical Review, 13 Park Row, New York City.
Zimmerman, William F.	U. S. Electric Lighting Co., Newark, N. J.

TENTH CONVENTION.

SEMI-ANNUAL MEETING

OF

The National Electric Light Association,

HELD AT THE CASINO, NIAGARA FALLS, N. Y.,

August 6, 7 and 8, 1889.

FIRST DAY'S PROCEEDINGS.

TUESDAY FORENOON, AUGUST 6, 1889.

The Convention was called to order Tuesday, August 6, 1889, at 10.30 A. M., by President E. R. Weeks, who thus addressed the Convention:

PRESIDENTIAL ADDRESS.

BY E. R. WEEKS.

Gentlemen:

We are met primarily to further the interests of local companies; secondarily, to aid in the general development of the business and to promote the good of manufacturers of electrical apparatus and supplies. Our Association combines both the commercial and scientific elements, and its deliberations are of a theoretical as well as a practical nature. Our chief work lies in calling attention to the needs of the business and to available improvements.

In this Convention are represented industries which embody the very forefront of progress, yet many of you come from lands where electric light and power interests have no legal status, or

are struggling under adverse enactments. I trust that the work of the Committee on State and Municipal Legislation will be so seconded that we shall soon be accorded just legal recognition.

While the arc light business is steadily increasing, the greatest development has been, and must continue to be, in other directions. The superiority of the incandescent light, as a supplement to the arc, is now more generally acknowledged ; but, owing to the commercial value of the residual products in the manufacture of gas, the incandescent light cannot compete with it in the matter of price. Without a perfect subway system and storage battery, it cannot be so reliable.

The Committee on Underground Conduits and Conductors will report progress and ask for more time.

It should not be inferred from the absence of this topic from our programme that its importance has been overlooked, or that nothing is being done in the direction of electrical subways. Hundreds of thousands of dollars are being expended in experimental work ; but many years must elapse before a complete solution can be reached.

The outlook for the alternating current is encouraging. More exact work is being done in this direction ; and the invention of meters and motors for this current has added greatly to its commercial value. The meters recently brought out should be of the greatest advantage. It is a fundamental principle that every business of any stability measures its commodity ; and customers are more confident of their service when they know that it is being measured.

We may feel gratified that our electrical apparatus is in demand in foreign countries, but this should not blind us to the fact that the criticisms of European engineers upon our streets and station construction are just. It is a hopeful sign, however, that both local and parent companies are paying more attention to good apparatus and the proper construction of lines and planning of stations. This becomes more necessary as business increases, and the price of coal advances, rendering a reduction in fuel all important. The increase in boiler pressure and the compounding of engines are steps in this direction. Schools, colleges and the larger electrical companies, are paying more attention to electrical education. Popular articles on the applications

of electricity are informing the general public as to the extent and value of our industry. With greater efficiency in apparatus, better trained men and more intelligent management, depreciation will be reduced, the conservatism of investors toward electrical securities will disappear, and capital will seek us.

Probably no other topic upon our programme will attract more general attention than the "Unconstitutionality of Electrical Execution." Whatever may be the opinion of scientists in regard to this mode of taking life, the whole movement is encouraging, in that it evinces the world's progress in sensibility.

One of the most important questions that will engage your attention at this session will be the report of the Committee on Harmonizing the Electrical and Insurance Interests. It is a matter of deep concern, not only to the producer, but to the consumer of electricity, that the electrical and insurance companies co-operate. To harmonize these interests will be to give one of the strongest impulses to electrical industries.

Electric welding is winning its way to a commercial basis, and is destined to occupy an important place in mechanics. But by far the greatest activity at present is in the direction of the transmission of power. The electric motor is working a complete revolution. It is impossible to forecast its future. The field of the stationary motor is practically infinite, and is almost virgin soil, while the mileage of railroads now operated by electricity, though rapidly increasing, is still so small, compared with the total railroad mileage, as to barely suggest immense possibilities.

Statistics collected by our Secretary show that the number of arc lamps in service in the United States alone during the last six months has increased from 219,924 to 237,017; that of the incandescent lamps from 2,504,490 to 2,704,768; the number of street railroads operated by electricity is now 109, comprising 575 miles of track and 936 motor cars. The capital now invested in these industries amounts to $275,000,000.

These facts bring most forcibly to our attention the financial importance of the interests which we are here to represent, and should impress deeply upon the mind of each member his individual responsibility and the necessity for doing his utmost, both by regular attendance and close attention to the work in hand, to accomplish the objects for which we are assembled.

At the conclusion of his address, the President introduced Hon. W. C. Ely, of Niagara Falls, who delivered the address of welcome, as follows:

SALUTATORY ADDRESS.

BY HON. W. C. ELY.

Mr. President and gentlemen of the Convention:

To me has been delegated by the Chairman of your Executive Committee the agreeable duty of extending unto this Convention a welcome greeting on the part of the citizens of Niagara Falls.

It has been customary from ancient times for communities to receive with honor and evidences of pleasure, persons of high rank or distinction visiting within their walls. The onward sweep of civilization has demolished walls and battlements, and the stranger enters at will the cities and towns of enlightened countries; but a modification of ancient customs still requires that a distinguished collection of guests visiting in a semi-public capacity shall receive from the community honor—suitable recognition. So I bid you welcome to Niagara Falls.

Indeed, you are very welcome. We have looked forward eagerly to the assembling of this Convention as an occasion fraught with interest and benefit to our locality. You are here; we hope you will do us good, and Niagara cannot but benefit the members of this Convention.

The scenery of Niagara Falls—the Mecca that attracts travelers from all over the world—is now in its splendor; and it shall be part of my duty this morning, at the beginning of your visit, to endeavor to assist you somewhat in your enjoyment of the scenes of nature that await your inspection. Perchance, the most of you have seen the Falls, it may be, more than once, but how few of the thousands who come and go to view Niagara, get a full realizing sense of the beauty and grandeur of the Cataract and its accessories, only constant and close observers can tell. Some knowledge of the geology and history of the cataract and vicinity is necessary to excite in one to the fullest extent those emotions without which the fullness of appreciation of this great product of Nature's forces can never be realized.

You are experimenters with power and force, you deal in it, you generate it, utilize it and profit by it. The item of profit is a stimulus to your brains and energy. You are the devotees of a force, the latest, the most interesting, to which all thoughtful men are now looking for the solution of some of the most difficult economic questions of the hour. To you then will appeal in all its grandeur, this mighty waterfall, the grandest manifestation of physical power upon the face of the globe. As such it is most interesting, most wonderful. Niagara is beautiful, but other places compare with Niagara in beauty, but as an exhibition of merciless, irresistible power it is stupendous, overpowering, and the only feelings akin to those with which in the gorge below one gazes upon its madly falling waters, are those inspired by the sight of the waters of the ocean, when, from the hurricane deck of a storm driven vessel, wherever the eye may reach it falls upon the angry waste of waters, stormbeaten, tempestuous and threatening. As an exhibition of wild, untrammeled power, the Cataract and Rapids will most affect you.

The accepted geological explanation of the formation of the Falls is wonderfully interesting. Your attention will be called to it irresistibly by the thought which occurred to my mind the first time I ever descended into the chasm below the Falls. How could this have been hollowed out? This is not the ordinary flowing of a river between natural boundaries, there has been something unnatural here. A giving way before the attacks of some force against which the mighty walls of rock deep laid by Nature have rebelled in vain, and such has undoubtedly been the case.

If there ever was a time when the mountain barrier at Lewiston, six miles below this place, stretched across unbroken from East to West, there were then no River and no Falls, but the waters of Lake Erie covered the place where this building now stands, and for centuries its fretting waters were restrained by the natural barrier of the ridge just mentioned. Then there was no union with Ontario's waters and through the Des Plaines or the Calumick River into the Illinois, the waters of all the upper lakes found their way into the Mississippi and the Gulf.

That this was the case is easily demonstrable. The Lake surveys show that the surface or water level of Lake Michigan

is only 30 feet higher than the waters of Niagara River at Gill Creek, just East of the Rapids above the Falls. The water in the Des Plaines and Calumick Rivers is only 11 to 12 feet above the level of Lake Michigan, so that a barrier across the Niagara, 60 feet high, would have sent the waters of the lakes into the Illinois. This barrier existed in the ridge at Lewiston, 60 feet high and more than two miles wide. Against that barrier for centuries must have dashed the wind driven waters of Lake Erie, then more forcible because of their greater volume, until at last some terrific wind storm raised some mighty tidal wave and, hurling it against the barrier, weakened and narrowed by continued erosions, it surmounted the obstacle and the waters denuded the top of the ridge of its gravelly deposits and swept over into the lowlands beyond. Continued washings followed and the disintegration of the rocky barrier was assisted by the action of the frost, air, and the action of the ice, until, finally, a channel was excavated lower than the waters above, and the Cataract was begun. From that time to the present the ceaseless action of these great forces has continued and the thunder of the mighty Cataract has rolled down the corridors of the centuries while it has receded southwardly through seven miles of solid rock.

Such is the past of this wonderful waterfall; with what feelings of interest we speculate upon its future.

See the Falls and Rapids again and again; by sunlight and by moonlight. There is no more interesting place, none with scenery more diversified. From the crowd in Prospect Park, in five minutes walk to the centre of Goat Island, you may, in the words of Bryant,

> "Lose thyself in the continuous woods where rolls the Oregon, and hears no sound save its own dashings."

The history of the vicinity is fraught with interest to the sightseer. Along the banks of the Niagara the fierce and cruel Senecas waged unrelenting and exterminating war against the more docile "Neutral Nation," and from the time that the Chevalier Robert de la Salle entered the mouth of the river to the close of the war of the Revolution, the shores of the Niagara were dark and bloody ground. Five miles above this place La Salle, in 1679, built "Le Griffon," a vessel of 45 tons, the first

sailing vessel that ever navigated Lake Erie. The French traders of the latter part of the Seventeenth Century, coming from Montreal across Lake Ontario, entered the river at Fort Niagara, landed their boats at Lewiston, and with incredible toil carried their goods over the portage from that place to the river, two miles above this place. Along that portage, half way to Lewiston, in the French and Indian War a band of the cruel Senecas massacred two companies of English soldiers guarding a passing supply train, and but three persons escaped alive to relate the horrid details. Above the village stood Fort Schlosser and the French Fort Du Portage; across the river are the battle fields Chippewa and Lundy's Lane, and crossing the height opposite Lewiston the lofty monument that marks the spot where fell the valiant Brock in the battle of Queenstown Heights.

But it is merely as a natural wonder, not merely as a thing of grandeur and beauty, that you will look upon Niagara. For years the minds of power producers have been turned with longing towards the mighty Cataract, and with the rapid advancement lately made in the development of electrical power, there seems to have been a corresponding increase of interest in the capacity of the Falls, and from all over this country, and all parts of Europe, have come within the past three and a half years the suggestions, plans and schemes of all classes of men for the utilization of the power of the Niagara River. It has been suggested to me by the list of subjects of papers to be read, that some considerable part of the time of this body would be given to the consideration of water power in connection with electricity. And what more fitting topic could be chosen? Is it not true that the successful manipulation of electricity as a force for distribution is dependent in a great degree upon our ability to devote water power to its production? It seems to me it is so. The manager of one of the great lighting companies of a large lakeport city recently estimated that it cost his company for coal $40 per horse-power per annum. This granted at Buffalo would be true elsewhere. How greatly to be desired then becomes a steady unfailing water power costing *in toto*, say, from $10 to $15 per horse-power per annum.

So firmly am I of the opinion that the successful use of the

electrical force is dependent largely upon increased facilities of water power, that I believe we shall ultimately see all over this country immense reservoirs constructed in the mountain ranges where our large rivers and streams have their head-waters, and by means thereof available water power for electrical uses all over this country. Not structures like the fatal dam on the Conemaugh, but safely and securely built by the best engineers, they will prove more magical, far, than the lamp of Aladdin, sending forth a stream of effulgent light into all the dark places, and supplying to man a helper more economical and easily used than even steam, heretofore man's greatest aid in his contention with the mighty obstacles of Nature to the advance of civilization. If this be true, of how great interest to science and the world is the solution of the problem of the utilization of the furious, unbridled torrent of Niagara?

A plan has been formulated which solves the problem successfully. A rapid sketch of it would be understood quite thoroughly if the listener has in mind the topographical features of the river immediately below the Falls, and above them for a mile or two. But let me assist you in grasping the situation: To the eastward of the village for several miles the land is nearly level with the waters of the river, which there move slowly in a broad body; then the Rapids succeed, and then the plunge at the Falls, 160 feet; and below the chasm, 200 feet deep. From the water level in the chasm below the Falls it is proposed to excavate a tunnel 24 feet in diameter, extending under the village eastwardly at an ascending grade of one foot in 100 feet, which tunnel will approach within 400 feet of the river, just east of the present hydraulic canal, and at that point will be 125 feet below the surface of the land and the waters of the upper river; thence it will extend eastwardly with a slightly modified grade and parallel with the river about one and one-half miles, and at its easterly termination will still be 90 feet below the surface, and in diameter 10 feet, the same having been gradually narrowed to that limit in the last one and one-half mile of its length. This tunnel will serve as a tail race simply to discharge water. Immediately over and above this tunnel will be constructed lateral tunnels at right angles with the river and the main tunnel, and arranged to discharge into the latter. Over

and above the lateral tunnels and, like them, at right angles with the river and the main tunnel and upon the surface of the land, will be excavated surface canals, into which will be diverted the waters of the river. By the side of these canals wheel pits can then be excavated and into them turbine wheels placed at a depth of 100 feet below the surface of the land and arranged to discharge directly into the lateral tunnels below; and thence through the main tunnel or tail race and into the gorge of the river below the Falls. This system of transverse canals and tunnels would discharge 864,000 cubic feet of water per minute and furnish 119,000 horse-power, and this power is not situated in the midst of inaccessible mountain ranges but midway between New York and Chicago, on the Great Trunk lines of railroads, with unsurpassed shipping facilities.

The advantages of the situation are apparent at a glance. As enumerated by Thomas Evershed, the originator of the tunnel idea, and summarized by a very high engineering authority in his endorsement of Mr. Evershed's plans, they are: An exhaustless supply of pure water at a practically constant head, solid and durable rock containing all the tunnels, shafts and conduits, and furnishing solid and imperishable foundations for all the structures, and a practically uniform surface of the proper elevation of the lands necessary for manufacturing structures.

At Niagara Falls, then, is Nature's great store-house of power for the development of electricity and the successful answer to the question, what can be done in the transmission of power by electricity to a distance?

Sir William Thompson said that "Niagara Falls possessed more power than all the coal mines in the world." And a true appreciation of the idea impelled Edison to say that "Niagara is the greatest storage battery in the world."

This latter is absolutely truthful, and with the power of the waterfall developed by means of a hydraulic tunnel, a system of powerful dynamos to transform the water power into electricity, and this transmitted to Buffalo, that city might be supplied with light and power far more cheaply than at present, and the demonstration of the capabilities of electrical power and transmission afforded that would give us something more than the world has as yet had. The accomplishment of this work would solve the problem of rapid transit in the City of Buffalo.

Niagara Falls would then become the centre from which, after the perfection of the storage battery, electricity for furnishing power all over the eastern part of the continent would be duly shipped by the train load. And here at Niagara would then be inaugurated a series of experiments in this still mysterious force, which would be productive of the greatest economic results.

I speak of experiments. You will pardon me, but it seems to me that the knowledge of this wonderful fluid, if fluid it be, is largely experimental and scarcely exact. Indeed, it appears that the most scientific are not always most successful. It remained for a farmer near North East, so the daily papers say, to discover the means of utilizing a single wire simultaneously for telegraphic and telephonic purposes. And the bucolic inventor has evolved a dry battery which is to cheapen materially the operating of the telephone. This will interest you as stockholders on account of increased dividends. Consumers are not so green as to expect any reduction of rates. What I mean was well illustrated the other day at the close of the judicial investigation had for the purpose of ascertaining whether it was safe and humane to delegate to this subtle agent the functions of the public executioner, when the lawyer opposed to it in that capacity, said to a witness, "Ah, then you know as much as men generally do about it, do you? Well, that's more than the experts know." I hope Dr. Moses will help this Convention out on this subject with his valuable paper.

Gentlemen, you know why this town and its people are particularly glad to see you. We feel that you are to be interested in our projects and that from you we are to receive assistance. Niagara Falls has for years lain asleep by the side of the greatest mill dam and water power in the world, and she is now awakening to a sense of her misused or non-used power. Your aid will be valuable to her and her power of the greatest value to the electrical world. While you are here we hope you will enjoy every moment. And again, gentlemen, I assure you that you are most welcome to Niagara Falls.

THE PRESIDENT: The Secretary will now call the roll.

The roll was called by the Secretary. (For list of members see the list at beginning of this volume.)

THE PRESIDENT: The Secretary will now read some communications.

The Secretary read the following communication:

MAYOR'S OFFICE, New York, July 17, 1889.

E. R. Weeks, Esq., President, The National Electric Light Association.

Dear Sir: I request your presence at a conference of representative citizens to consider the advisability of holding an international exposition at New York, in 1892, and to arrange for the preliminary work if it is deemed advisable. I hope you will be kind enough to attend at my office on Thursday, the 25th of July, at 3.30 o'clock.

Yours truly,

(Signed) HUGH J. GRANT, *Mayor.*

THE PRESIDENT: I greatly regret that I could not attend the meeting, and I hope the Association will take appropriate action on Mr. Lynch's resolution now in the hands of the Executive Committee, looking towards the co-operation promised Mayor Grant in my answer to the invitation with which he has honored us.

MR. A. J. DE CAMP (of Philadelphia): I move that the question of appointing a committee to co-operate with Mayor Grant in the carrying out of the project to hold a World's Fair in 1892 be referred to the Executive Committee.

THE PRESIDENT: Are you ready for the question?

MR. J. F. MORRISON (of Baltimore): I do not think it would be good policy to refer anything to the Executive Committee which belongs to the Convention. I believe that this matter ought to be acted upon in open Convention; and, with all respect to Mr. De Camp, I suggest that he withdraw that motion until the afternoon session.

MR. A. J. DE CAMP: It was my aim to have that come before the whole Convention, but simply to refer it to the Executive Committee to formulate, and report to the Convention.

MR. MORRISON: Very well, if your motion is so amended.

MR. F. E. DEGENHARDT (of Chicago): I wish to know if we are to commit ourselves to holding the World's Fair in New York. It strikes me that Chicago is in the field for this Fair, and I would like, on behalf of the Mayor of Chicago, Mr. Cregier, to submit for your consideration a proposition from our Mayor looking to that end. I suppose, however, it will be the province of the Committee to consider that matter.

THE PRESIDENT: As we have no communication from Chicago, it seems to me that Chicago is about to be left on this measure. (Applause.)

MR. BENJAMIN RHODES (of Niagara Falls): Let me suggest that there is a Chicago man on the Executive Committee.

The President put the motion, as follows: That this question be referred to the Executive Committee, who will report to the Association in Convention at some subsequent session.

MR. MORRISON: At the beginning of the afternoon session?

THE PRESIDENT: At the beginning of the afternoon session.

MR. H. W. POPE (of Elizabeth, N. J.): The Committee take no action upon the resolution?

THE PRESIDENT: None whatever. It comes before the Convention for action.

The President put the motion, and declared it carried.

Mr. Morrison moved to adjourn and withdrew the motion upon the President stating that Mr. Rhodes desired to make an announcement.

MR. RHODES: On behalf of the Executive Committee, I wish to make one or two announcements looking to the pleasure of the members of the Convention and their friends. After business is over this evening, the members are invited to attend an excursion, which will leave the New York Central Railroad depot at seven o'clock, going down the river to Lewiston by the excursion train, in view of the Rapids, and taking the boat at Lewiston and going down the river for a short moonlight ride. Those who have taken this trip know that it is a very pleasant one, and those who have not taken it may be assured that if the evening is as pleasant as it bids fair to be, the trip will be worth the trouble. It is necessary to say that the train will start at 7.15, and it is requested that all those who take part in this excursion be promptly at the New York Central Railroad depot at 7 o'clock, so that they may be on the train in time, and that there may be no delay. The track from Niagara Falls to Lewiston is a single track, over which the trains run very frequently, for the purpose of viewing the scenery, and it is necessary, in order not to delay the trains, that they start promptly at 7.15. No ticket will be necessary, and it is requested that those who wish to go and take their friends, will make it known to their friends that the excursion is for their benefit.

To-morrow evening there will be a reception and promenade concert at the International Hotel, to which all members of the Convention and their friends are invited.

The Executive Committee will meet immediately after the close of this session at Parlor A, International Hotel.

It was moved and seconded that the Convention adjourn to 2.30 P. M.

MR. FRED. H. WHIPPLE (of Detroit, Mich.): Chicago time or New York time?

THE PRESIDENT: New York time. The limit of Chicago don't quite take in this place yet. (Laughter.)

The President put the motion and declared the Conyention adjourned until 2.30 o'clock P. M.

FIRST DAY'S PROCEEDINGS.

AFTERNOON SESSION.

TUESDAY, AUGUST 6, 1889.

The Convention was called to order at 2.45 o'clock by the President.

THE PRESIDENT: Owing to the fact that the Secretary's baggage has gone astray, we will have to shift from the regular topics. We will, therefore, now hear from Chairman Rhodes the report of the Executive Committee.

PRELIMINARY VERBAL REPORT OF THE CHAIRMAN OF EXECUTIVE COMMITTEE.

MR. RHODES: Your committee is a large body and, as you know, large bodies move slowly. The Committee had a formal meeting at Chicago at the close of the last Convention, and the next meeting of that Committee was held this morning. A large amount of the business of the Association was delegated by that Committee to sub-committees formed of its members, and much of that work has been done and well done. Those sub-committees have only reported this morning, and it is necessary, as has been customary at this Convention, that the Executive Committee should wait until later in the proceedings before presenting its formal report; but at the meeting held this morning a matter was brought up which was referred to the Association in Convention assembled. That was the invitation of the Mayor of the City of New York to this Convention to appoint a member who should act in conference with his Honor the Mayor in reference to the proposed exposition in New York, in 1892. I am instructed by the Executive Committee to state that this resolution had been passed by the Executive Committee:

"*Resolved*, That this Executive Committee recommend to the Association that the President be authorized and directed to appoint a committee of five members on the pending International Exposition to be held in 1892, whose Chairman shall represent this Association on the Conference Committee called for by his Honor the Mayor of New York City, to aid in making the Exposition a success."

On behalf of the Executive Committe, I move that the resolution be adopted, and that the instruction be carried out—that the President appoint a committee of five members.

MR. DEGENHARDT: Before accepting the resolution as offered by the Executive Committee, I would like to state that I have in my hand a telegram from Mr. J. P. Barrett, of Chicago, in which he says he is sending a telegram asking the Mayor of Chicago to request that a committee be appointed to co-operate in the efforts towards holding the World's Fair in the City of Chicago. I desire to offer as an amendment to the resolution offered, that it be the sense of this meeting and that the President so instruct Mayor Cregier, of Chicago, as well as Mayor Grant, of New York, that we accept their kind offer with thanks, but at this early day where the entire matter is problematical, it is utterly impracticable to declare ourselves in favor of either city. If we declare at all, let it be Chicago. (Laughter.) Why not Chicago as well as New York. I am not in favor of going on record with my vote in favor of that resolution, except as amended. I move that as an amendment to the resolution.

MR. RHODES: Mr. Chairman, in order to postpone or entirely put off a matter which may possibly come up here and take the entire time of this Convention this afternoon, as it took the time of the Executive Committee, during almost the entire interim of the morning session, I will state how this came up in the Committee. The question was raised whether this Association should commit itself to a World's Fair in 1892 at New York, in opposition to a World's Fair in 1892 at Chicago, Washington or some other city, and the Executive Committee decided that it could not take ground on that point—that it is not best at this point to commit itself in favor of any city. But on this question we decided that we had before us an invitation from the Mayor of the City of New York to appoint a man, not to forward, understand—not to vote for a World's Fair in New York City, but simply, to accept a courteous invitation from the Mayor to appoint a man from our Association to meet with them as a Com-

mittee of Conference. I hope this matter will not come up for discussion between the cities of New York and Chicago or any other cities, but that it may be treated simply as a courteous invitation, to which we are returning a courteous answer.

MR. W. A. KREIDLER (of Chicago, Ill.): It seems to me that the report or resolution is not worded so as to express exactly what the Committee means. Now, it is a fact that when they went into session they only had a communication from the Mayor of New York, but it seems to me that we must now take into consideration the Mayor of Chicago, and I think the wording should be changed so that there will be no doubt about its meaning and about the willingness of the Association to co-operate with either Mayor of the cities who have addressed an invitation to us. I do not think it is a question between New York and other cities, but simply of New York and Chicago, because those are the only invitations we have to consider to-day.

THE PRESIDENT: I demur to what the gentleman says in regard to the Fair being held in Chicago. I think that on account of its central geographical location, and the great number of railroads there centering, Kansas City should be the point. (Laughter.) But, gentlemen, that is not the question. The Mayor of Kansas City is not on the records of the Association with an invitation to the Association to co-operate with him, neither has the Mayor of Chicago sent such an invitation. We received a telegram from a gentleman connected with the Mayor in an official capacity in Chicago, at the eleventh hour. I think the communication from the Mayor of New York has been received several weeks, and has been replied to by the President of this Association on general principles, assuring him that he might have the co-operation of the interests represented in this Association, looking to the holding of a World's Fair, not especially in New York, but anywhere. Now it seems to me, gentlemen, that the action proposed by our Committee does not commit the Association to any locality, but is purely general and is imminently in order.

MR. GEO. M. PHELPS (of New York): Mr. Chairman, I do not think that any of the gentlemen who have spoken, if about to answer an invitation to dinner, were told that somebody else was about to send him a letter of invitation to another dinner

the next morning, I do not think he would pass the question on that account, and my opinion is that we are invited simply to co-operate in organizing a World's Fair in New York. Now, we hear that Chicago has some notion of having a World's Fair, too —we have one invitation before us and are told that we may get another. When that comes we can answer that.

MR. ALEX. KEMPT (of Chicago, Ill.): Mr. Chairman, I understand the position to be this: The gentlemen of Chicago do not desire that this Convention, in any shape or manner, shall delegate to New York any preference in the question of the location of the World's Fair. That the electrical fraternity should be represented at the New York effort is proper and fitting, but that this Convention should not indicate its preference for New York, Chicago or any other city. I think if that is the animus of the resolution, it is right; that this Convention do not make a selection.

MR. CHARLES A. BROWN (of Chicago, Ill.): I coincide heartily with what Mr. Kempt has said, and with what Mr. Kreidler said before, and I further agree with Mr. Kreidler that the resolution read by Chairman Rhodes does not thoroughly express the idea it intends. Mayor Grant has sent an invitation, taking it for granted, just as Mayor Cregier, of Chicago, would take it for granted, that the World's Fair is to be held in Chicago. Steps have been taken and money subscribed, just as in New York. Now, an invitation from Mayor Grant, based upon that assumption, if responded to in the way suggested by Mr. Rhodes, does commit the Association to the World's Fair in New York. I cannot see any way out of it. We may say that it does not, but the effect of such action is to actually commit us. I, therefore, offer in substitution for that resolution the following:

Whereas, The location of the World's Fair has not yet been determined upon; and

Whereas, The National Electric Light Association will have several meetings between the present time and the time designated for the said World's Fair;

Resolved, That it is the sense of this body that a vote of thanks be tendered Mayors Grant and Cregier for their recognition of this Association; and that the president of this Association, in formally expressing to Mayors Grant and Cregier our appreciation of their courtesy, should state that a committee will be appointed at the proper time to represent the electrical interests in the

World's Fair, wherever it is to be held, without expressing at present any preference as to the location.

MR. P. H. ALEXANDER (of New York) : Mr. President, I think that this last resolution should come up some time, but not at present. The Mayor of New York City advises this Association that a World's Fair is to be held in New York City in 1892, not *the* World's Fair, but *a* World's Fair. We just learned that Chicago intends to hold one in the same year. But we are dealing now with an invitation of Mayor Grant, of New York City. He has not done as the Mayor of Chicago has done, selected his committee, but he has sent around to the different organizations representing trades and businesses of all kinds, and asked them each to appoint one man who shall be the representative on the committee of 100 that he is forming, irrespective of any other city. He does not seem to have any jealousy whatever. He merely asks all the trades to come in and help him in the organization, by appointing a man of their own kind. He honored this Association by such an invitation ; he thought they were broad-minded men—men of national ideas—not in favor of New York, or of Chicago, or of Kansas City ; he merely asked the Association to appoint a man upon that committee. If this man is to be appointed, his name must be sent in before next Friday. Consequently, any other answer we may give, except the appointment of the man, would be an evasive answer or a discourtesy to a man who, out of 100 men, only asked this Association to appoint one. I think it is a great honor conferred upon this Association.

MR. KREIDLER : I want to second Mr. Brown's motion. It seems to me that Mr. Alexander is playing upon words. We all know that New York is not going to hold *a* World's Fair, neither is Chicago. If *the* World's Fair is held in New York it will not be held in Chicago, and if it is held in Chicago it will not be held in New York. If it is to be in New York, nobody will be more willing than the Chicago members to make it a success. But we do not want to commit the Association to anything just now, and that is why this substitute of Mr. Brown's has been offered, and I want to second it.

MR. DEGENHARDT : Mr. President, in rising to second Mr. Brown's resolution, I wish to put myself right before the Con-

vention. I am under the impression that they thought I was not willing to thank a man for his courtesy. I believe Mr. Brown's resolution covers the question. If the word Chicago is to act as a red flag, strike the word out. There should be no expression in favor of any city. My judgment is that we have as good right to demand for the City of Chicago the recognition that Mr. Weeks has asked for Kansas City. I don't know that, in speaking of the broad gauge of the gentlemen here, that it savors of narrow gauge when we shout for our own territory. The allotment of this Committee by Mayor Cregier was done with a view of ascertaining what co-operation can be had throughout the United States to bring this World's Fair to Chicago. The same thing appears to have been done by Mayor Grant, of New York. The position is identical.

MR. DE CAMP: Do I understand that we have a communication from the Mayor of Chicago?

MR. DEGENHARDT: I understand there has been an official communication from J. P. Barrett, who acts for Mayor Cregier.

MR PHELPS: Would it not be time enough to answer the Mayor of Chicago when you hear from him?

MR. DE CAMP: This courteous letter from the Mayor of New York is a compliment to this Association, and one which demands a prompt and positive reply. I do not see that this Association commits itself in a single degree by responding to that favorably and reporting that committee at once. If Mayor Grant fails to have the Exposition held in New York, then the whole thing falls, and some other city will take it up; but as the matter stands to-day, New York is unquestionably ahead in that matter. (Applause.) Now, it is three years ahead, but three years is a very short time to provide for an Exposition of that kind; it ought to have been five. Now, it is a fact that the Mayor of New York is ahead, and if anybody comes in later, they are going to suffer for want of time. We have either got to reply to that or not to reply to it, but if we reply to it at all, I think we should make a positive reply, because Mayor Grant means business. He wants somebody to represent this interest, and if the gentlemen connected with it cannot represent it, the interest will probably go without representation. I think we have everything to gain and nothing to lose by passing this resolution.

MR. BROWN: Mr. President, the point made by Mr. Kreidler and Mr. Kempt seems to be not to have been answered. I deem it entirely possible to answer Mayor Grant and to appoint a representative to meet him, but if we do that under the language used in the resolution offered by Mr. Rhodes, we will not then be in position to make any reply to Mayor Cregier when his invitation in equally strong terms comes to us. This resolution, I think, is in the nature of a promise; that is, it does commit the Association. I think Mr. Rhodes' resolution does commit the Association, and, therefore, I sincerely wish that the Convention would consider carefully the language of the two resolutions before it commits itself, as I think it would by voting affirmatively on Mr. Rhodes' resolution.

Calls for the question.

MR. WEEKS: Gentlemen, the question is on the substitute offered by Mr. Brown, in place of the original resolution by Mr. Rhodes.

It was requested that Mr. Rhodes read the original resolution, which he did.

MR. WHIPPLE: Mr. Chairman, is an amendment to that in order?

THE PRESIDENT: One moment, please, until we have the resolution read.

Mr. Brown's amended resolution was then read, and upon being put to vote it was lost.

MR. BROWN: Mr. President, I call for the roll.

SECRETARY GARRATT: Why not have a standing vote.

THE PRESIDENT: I believe it is competent for ten members to require the call of the roll.

The President requested those in favor of the call of the roll to signify it by rising. Upon count, the Secretary found but nine members standing, so that the request for call of roll was lost.

MR. MORRISON: I think the roll call is out of order.

THE PRESIDENT: The decision of the Chair was that 10 members would be competent to require a call of the roll. I believe that has been the practice on former occasions.

MR. MORRISON: I have never known a vote to be taken by roll call. A rising vote is sufficient. If you will permit another word, I will explain. There are hundreds of names on the roll

who are not present. It would be a waste of time to call the roll, which time can be saved by a rising vote.

MR. BROWN: I would like to read from the Constitution. "On any question a ballot may be taken by 10 members present; a ballot cannot be taken by a rising vote."

THE PRESIDENT: I so construed it.

MR. MORRISON: What Constitution is that, Mr. Brown?

MR. BROWN: It is a Constitution I have received from the Secretary. It is headed "New Constitution of the National Electric Light Association," and dated 1888.

SECRETARY GARRATT: That is the present Constitution. A standing vote with the names of the persons standing written down is equivalent to a roll call.

MR. MORRISON: The point that Mr. Brown refers to, a vote by ballot, is not on a question of a resolution.

THE PRESIDENT: To save time, Mr. Brown, it seems to me a rising vote should cover this case. The time of the Convention is valuable.

MR. BROWN: I will waive my motion and substitute a rising vote for the roll call. (Applause.)

THE PRESIDENT: The question is on the substitute. Those in favor of the substitute of Mr. Brown's for the resolution reported by the Executive Committee, will signify it by rising to their feet.

Upon count, the Secretary stated that 13 members were standing.

THE PRESIDENT: Those opposed will so signify by standing.

Upon count, the Secretary announced that 14 members were standing. The count was verified by Mr. Brown.

The motion in favor of the substitute was lost.

MR. BROWN: Mr. President, I move you that the resolution offered by Mr. Rhodes be amended by striking out the last clause in that resolution: "In making the Exposition a success."

MR. ALEXANDER: Mr. President, it seems to me that we are misunderstood. The Committee is called by the Mayor as a Committee of Conference, to "aid in making it a success."

MR. KREIDLER: I made the remark that the Committee seemed to have the right idea of the matter, but have not worded it properly, as we interpret it. A few words put in that

resolution or a few words taken away, as Mr. Brown suggests, would make it entirely satisfactory to everybody and still render it entirely possible to send Mayor Grant a satisfactory and decent reply. It seems to me that it would be a good deal better if we would use Mayor Cregier's name in addition to that of Mayor Grant. A few words changed in the resolution will do away with a good deal of feeling. If it is the intention of this Convention to commit this Association to the New York idea, of course, they can do it by carrying the resolution as it stands.

THE PRESIDENT: That is not the intention. It is moved and seconded to so amend the original resolution by striking out the last clause.

MR. RHODES: "To represent this Association at the conference called for by his Honor, the Mayor of New York City." These words are not the words of the Executive Committee, nor of any person who offered this resolution. They are an extract from an expression of the Mayor of New York:

Resolved, That this Executive Committee recommend to the Association that the President be authorized and instructed to appoint a committee of five members on the pending International Exposition, whose chairman shall represent them—that is to say, "on the Conference Committee called for by his Honor, the Mayor of New York City."

MR. ROBERT L. MORRIS (of Nashville, Tenn.): I am in favor of an open field and a fair fight. New York and Chicago are making a bid for this Fair. The door is left open to us. If Chicago asked for a member from this Association, it would not be inconsistent upon our part to give them a man upon their committee also, but as the resolution is worded, it seems to me to commit this Association to New York, and to throw your influence and your vote in its favor. Now, I say, let us leave that door open and we do leave it open when we strike out these words. That complies with Mayor Grant's request to give him a committeeman. If Chicago asks for one we will give them one.

DR. OTTO A. MOSES (of New York): I think the exception taken by the gentleman from Chicago is, if we look at it from a literary point of view, quite correct. There is no necessity to add to it, "to aid in making it a success," because it would be a

discourtesy to carry any double meaning. Therefore, I think, and second the motion of Mr. Brown, that these words be erased.

Upon motion, duly seconded, the amendment proposed by Mr. Brown was carried.

MR. W. H. POPE (of Elizabeth, N. J.): With the view of acting in conjunction with them in the appointment of this representative—

MR. PHELPS: The resolution provides that the man shall be the representative of this committee.

MR. ALEXANDER: It seems to be impossible for this Association to get a representative on that committee. The committee has not time to correspond about it, because he must be appointed before Friday next. If it is the intention of Mr. Pope to defeat this motion, he uses the right means to do so, in proposing they should correspond about it.

MR. POPE: That is not my intention; but there are a great many interests not represented in this Association who ought to have a voice in the appointment of this member of the committee of the Mayor. That is why I offer this amendment.

MR. MORRISON: Mr. President, it strikes me that the amendment is superfluous. Let us take a look at the case just as it stands. The Mayor of the City of New York wrote a letter to the President of The National Electric Light Association and asked him to meet him at a certain day to confer with him as to certain methods to be adopted in the organization of the proposed World's Fair. To this the President of The National Electric Light Association replied that it was impossible for him to meet the Mayor of New York, but that The National Electric Light Association, he felt sure, would aid in every way to make an affair of that kind a success. To-day you have to deal simply with the Mayor of New York; you have to deal simply with the invitation. It is a question as to whether you accept it or reject it. He is the chief magistrate of the metropolis of this country, the commercial metropolis of this country. If he were the chief magistrate of any other city the same courtesy would be due from this Association as is to-day due to the chief magistrate of New York. If the Mayor of Chicago had sent to this Association or to its President, a communication

of exactly the same character, I would be on my feet advocating for the Mayor of Chicago exactly the same courtesy and polite treatment that I now ask of you for the Mayor of New York. As to the amendment, I beg to say that The National Electric Light Association has to-day, and will have for some time to come, all it can attend to to mind its own business. It is not here for the purpose of choosing representatives or making channels through which representatives of other like bodies in this country can come. It is not here to deal with the Telephone Association, or the Engineers' Association, or any other association, except the National Electric Light Association, so that upon that ground I should deplore tacking on an amendment of that character, which can do no possible good and may do some harm. There is nothing in this matter to consider at all. The promptings of your own decent instincts will show you the way out of this difficulty. It is to reply to the Mayor of New York with a courteous answer. I admit that this resolution is in the proper language. If a message comes to this Association, before its adjournment, from the Mayor of Chicago, I shall advocate precisely the same treatment of it which to-day you accord to the communication from the Mayor of New York. I hope that you will think of these things as you go along. It is a plain case and one that ought not to take two minutes to dispose of. If the Mayors of forty other cities send communications to you, reply to them in the same way. You have representatives from almost every city in the United States. Men naturally look out for the interests of their home localities. Men who are the pride of New York, both in the city and out of it; men who are the pride of Chicago—a phenomenal city. Every man is proud of his own locality and will stand up here to advocate it. Under proper circumstances, the bringing to his own city of any public meeting of large proportions would advertise his city and bring to it trade. But we have before us one simple, single proposition. Yield to that. When the other proposition comes, yield to that. You have lots of business ahead of you here and have plenty to do between the morning and evening, and you will find your hands full if you deal with these things which bear directly upon the business of the Association.

MR. POPE: I have no desire to retard the progress of this matter. I appreciate the position. My only desire was to give everybody a chance. I withdraw the motion.

THE PRESIDENT: The question is on the adoption of the resolution as offered by the chairman of the Executive Committee.

Upon motion, duly seconded, the resolution was carried.

THE PRESIDENT: We will now hear the report of the Committee on the Revision of the Constitution and By-Laws, through its chairman, Dr. Otto A. Moses, of New York.

DR. MOSES: Mr. President.

THE PRESIDENT: Dr. Moses—— Gentlemen, I hope you will keep your seats. This matter is of great importance.

PRESENTATION OF REPORT OF COMMITTEE ON REVISION OF THE CONSTITUTION.

DR MOSES: Mr. President, I have the pleasure, as chairman of the Committee to Report upon the Revision of the Constitution, to offer the following as the unanimous report of our Committee. We had to arrive at the facts and the propositions made in this by means of a very extensive correspondence. We have now on file in the hands of the Secretary about 125 answers from the members of this Association, to whom were referred questions which were crystallized in this report. From a majority—from a very large majority—of answers, it became possible for us to offer this, as I might call it, almost unanimous opinion of the members of the National Electric Light Association. For convenience of the members, this report has been printed in such a way as to be opposite to the old Constitution--the present Constitution—that is, on the left hand column; on the right hand column is the proposed Constitution, and I will read Article First.

Dr. Moses then read Article I of the printed Constitution:

ARTICLE I.—*Name.*

This Association shall be entitled THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

MR. ALEXANDER: Mr. President, as no amendment can be voted upon on the day of its first presentation, I move you, sir, that printed copies of this proposed Constitution be distributed among the members, and that this business be made a special business for Thursday morning, at 11 o'clock.

MR. EUGENE T. LYNCH, JR., (of New York): I will second

the motion, but I suggest as an amendment that it be made to-morrow morning, at 10 o'clock.

THE PRESIDENT: I would say that the printed copies of this report of the committee are in the boxes that have gone astray, which we expect to receive any moment. Directly that package arrives, those copies will be distributed to the members. Does Mr. Alexander accept the amendment?

MR. ALEXANDER: I should make it to-morrow afternoon.

MR. LYNCH: We have a special order of business for to-morrow afternoon—the electrical execution cases.

MR. ALEXANDER: We have a number of representatives of insurance interests here who are very anxious to get back to-morrow, and there are certain matters to come up to-morrow morning to be discussed before them and with them.

MR. LYNCH: I withdraw my amendment.

MR. DE CAMP: Is it the first order of business on Thursday morning?

MR. ALEXANDER: I made it 11 o'clock.

MR. DE CAMP: I do not know, but I think the last day of this Convention—this is practically a new Constitution, and it comes up in the form of an amendment to the old Constitution. Now, if any amendment that may be offered to this amendment come under the restriction of the Constitution, which says, that shall be laid over for a day, then what object is it to have it come up Thursday? It should come up to-morrow, so we can get rid of it. Will the Chair decide that question?

THE PRESIDENT: The Chair rules that such amendment would have to lie over.

MR. DE CAMP: That is an amendment to an amendment?

THE PRESIDENT: Yes, sir.

MR. DE CAMP: Then I hope the resolution offered by Mr. Alexander will not prevail.

MR. ALEXANDER: Do I understand that an amendment to an amendment must lie over?

THE PRESIDENT: I so understand it; no amendment can be voted upon on the day of its presentation.

MR. S. A. DUNCAN (of Pittsburgh): Once the report is before the body and acted upon, *in seriatim*, section by section, it is the property of the body. It is not then an amendment to the Con-

stitution, as it provides for something which is original matter. Therefore, if the Chair will consider, he will see the position—that you can alter, change or amend, any word of the subject matter properly brought before you.

MR. DE CAMP: That is the view I take of it.

MR. BROWN: But, Mr. President, there might be entirely new amendments offered, and they would certainly have to be laid over under our present Constitution.

MR. DE CAMP: Then there is a possibility of never having an amendment pass this Convention. It is possible there may be some more striking incident than this—a case where it would have to lie over.

THE PRESIDENT: A motion is before the Convention to make it a special order of business for 11 o'clock Thursday morning. The point was raised as to whether an amendment to an amendment could be considered without laying over, as provided by our present Constitution. The Chair held that it could not be acted upon. I think, however, after hearing from Mr. Duncan and Mr. De Camp, that the Chair will have to recede from his position.

MR. MORRISON: I think so. The object in presenting this paper is in answer to the demand made for certain amendments to the old Constitution. It was submitted to the last Convention and sent over to a committee composed of the representatives of the various interests represented in the Association—the electrical supply men and others—and in the committee they have formulated an amended Constitution, based upon the information which they have received by mail, as I understand it, as to what would best serve the interests of a majority of the members of the Association. Now, it is to deal with that paper that we are called. If you take it up to-morrow or Thursday, or whatever day you take it up, I judge that the members of this Association will desire to dispose of it as quickly as possible. It does not go with the saying that the provisions of that Constitution will be adopted. It is simply the report of the Committee. The Committee was created by this Convention, and its work will have to be passed upon by this Convention; but if you take up the paper with the view of disposing of it, article by article, there will be no difficulty with getting through with it in a very

short time. Every one will be prepared to present his views as it comes up, but there is one point you have not considered. There is no Constitution you can pass now that will be operative until after the expiration of the fiscal year.

THE PRESIDENT: We certainly could not legislate members out of the Association.

MR. MORRISON: No sir. The gentlemen here have paid their $20 for active membership in the Association. I have paid my rent for 12 months, and you cannot put me out until the expiration of the year, and you can pass no legislation which will take from them the right which they have paid their money for. So before you get through you will have a motion to leave that matter until the time comes when the paid term of these gentlemen has expired. These gentlemen have paid their rent for a year. I think we ought to take up and dispose, as far as possible, of each paper as it comes along. We are here for the purpose of profit. I do not see as it makes any difference whether you take this paper up to-morrow or Thursday, however.

The motion being duly seconded, was carried as amended by Mr. Alexander.

THE PRESIDENT: We will now hear the report of the Committee on Underground Conduits and Conductors, of which Mr. Lynch is chairman.

REPORT OF COMMITTEE ON UNDERGROUND CONDUITS AND CONDUCTORS.

MR. LYNCH: On behalf of the Committee, I will report that the Committee has decided to ask the Association for a little longer time to make a report—that it be delayed until the next annual meeting of the Association. It is a very short time, only six months since we made our last report, which was rather long and provoked a great deal of discussion, and we respectfully request that the time be extended until the next annual meeting.

MR. MORRISON: It is the Report of the Committee and it is a question of the adoption of the Report of the Committee. If you adopt it you only continue the Committee. I think they are getting ready to make a report down in New York. (Laughter.)

On motion, duly seconded, the report was adopted and the Committee continued.

THE PRESIDENT: Owing to the fact that Mr. Alexander's

manuscript is in that lost box, we will have to pass the report of that Committee. We will now hear from Mr. A. F. Foote, of Cincinnati, on the value of economic data to the electric industry.

Mr. A. R. Foote then read the following paper:

THE VALUE OF ECONOMIC DATA TO THE ELECTRIC INDUSTRY.

BY A. R. FOOTE.

1. All data have an economic basis. True progress depends upon the right use of correct data. Without such use of such data, no problem can be solved, be it industrial, political, social or religious.

2. To-day, every proposal for improving the condition of mankind is based upon data. Read:

1. Economic Aspect of Trusts. By George Gunton. *Political Science Quarterly*, September, 1888.

2. Remedies of Social Evils. By Edward Atkinson. *The Forum*, April, 1889.

3. Legislative Injustice to Railways. By Henry Clews. *North American Review*, March, 1889.

4. Signs of Impending Revolution. By William Barry. *The Forum*, April, 1889.

5. The Relation of Modern Municipalities to Quasi-Public Works. Publications of the American Economic Association, Vol. 2, No. 6, January, 1888.

6. Looking Backward. By Edward Bellamy. Houghton, Mifflin & Company, Boston, Mass.

7. Robert Elsmere. By Mrs. Humphrey Ward. George Munro, Publisher, New York.

You will find that the direction and strength of all argument is centered on the testimony of evidence obtained from the history of experience. Experience, truthfully recorded and properly understood, is the source of all value in knowledge.

3. The electric industry is based on the experience gained by the utilization of the discoveries of science which preceded it. Its development depends upon a truthful record of its own experiences, and the adaptation of the instruction derived from its own data.

4. To secure the best results for manufacturers, for those who invest in central station plants, and for the users of their services, the data of the industry must be reliable, complete and accessible. It should cover all apparatus, every operating plant, and the price paid for services rendered in every locality. If such a record can be obtained and maintained from year to year, it will be found that the science of data and the command of those agencies by which it may be obtained and utilized, is the most impor-

tant factor in the development of the industry. As is the prosperity of the users of service, so will be the prosperity of the suppliers of service. As is the prosperity of the buyers of apparatus, so will be the prosperity of the manufacturers of apparatus.

5. The electric industry has been born and carried to its present state of development within one decade. This is evidence of the marvelous skill and honesty of manufacturers, operators and users. The value of this testimony is enormous. It is proof of an average intelligence, a reliability of character and workmanship, far superior to the attainments of any other generation. It furnishes a reliable foundation, on which future development can securely rest. It is the prophecy of the accomplishment of results, such as have never before blessed any age.

THE VALUE OF ELECTRICAL AND MECHANICAL DATA TO MANUFACTURERS.

6. A long list of electrical and mechanical apparatus is assembled and used as one machine in the construction and operation of a composite central station. Every manufacturer of each part of this apparatus is vitally interested in knowing the exact truth regarding the performance of his specialty, under the widely varying conditions found in the practical operation of a large number of central stations. It is to his interest that he should claim for his specialty all the advantages it is capable of developing, and no more. The profit on a sale made on the basis of guarantees that cannot be realized, is a disastrous loss.

7. Inventors, designers and manufacturers, use their best efforts to supply a piece of apparatus that shall be the best for its purpose and price. They take careful note of all obtainable experience, and then attempt to take one step in advance by making an improvement. This is the natural law of progress. Their claims for their improvements are honestly made. They are based on tests made in laboratory or shop, where their apparatus is handled by experts under favoring circumstances. The value of improvement depends upon its advantages proven by the tests of practical use when operated by persons representing all degrees of skill, under the widely varying conditions found in a large number of central stations. If it is necessary to take careful note of past experiences, and to keep a careful record of the data of performance during construction, it is not much more necessary to keep a careful record of the data of a performance when in practical use? With such a record for a guide, manufacturers and buyers can feel a comforting assurance of certainty in their transactions. This, however, is not the most valuable consideration. Those who accustom themselves to keeping properly systematized central station records, for the purpose of testing the claims of manufacturers of electrical and mechanical apparatus, will become good observers. More often than otherwise, they can suggest some simple change in the apparatus which will enable the manufacturer to fully realize his expectations.

In fact, it may often be found that the manufacturer has claimed too little, instead of too much, for his improvement. If he can secure proper data from the operators of a large number of central stations, he can remodel his

claim as well as his apparatus in the light of recorded experience. This will make an enormous gain for him. It will enable him to base his business on a firm foundation not otherwise obtainable. In this there is surely sufficient reason for every manufacturer to encourage, in every way that is open to him, the keeping of systematic records by central station companies having for their object the collation, from experience, of electrical and mechanical data.

THE VALUE OF OPERATING, MAINTENANCE AND ADMINISTRATION DATA TO CENTRAL STATION COMPANIES.

8. Electrical and mechanical data are but one feature of the record upon which the success of central station companies depends. To complete the circuit, records must be kept of the data pertaining to all details of operation, maintenance and administration.

9. No manager can be equally competent in all departments. Unassisted he cannot observe all the details of the wonderfully complex business assembled in the operation of a composite central station. Upon the keeping of systematic records by his employés depends the ease of his position and the efficiency of his management. The value of a properly devised system of records of the daily operation of a central station can hardly be overestimated.

10. A manager may regard many items in his accounts as reasonable, representing the best that can be done, which, when compared with the accounts of some other manager, whose genius or experience has directed his attention especially to such items, will appear entirely out of the way. No better guide can be found, to where improvement is possible, than such comparisons. The value of the comparison increases in ratio to the number of accounts with which it is made. It is, therefore, to the interest of every central station company to do all in its power to induce every similar company to be represented in an organization through which the desired data can be made available to each.

11. While managers of central station companies can render service of undoubted value to manufacturers by keeping truthful records of electrical and mechanical data, manufacturers can repay managers *in kind* by suggesting improvements in their methods of operating their plants. A manager is isolated. He can observe his own work and methods only. The representatives of manufacturers are everywhere. They observe the work of all managers and are quick to detect the methods of those under whose management their particular specialty produces the best results. Having found this, it is to their interest to communicate the information to every user of such apparatus. Thus, by each manufacturer looking after his own interest, each manager will receive the educational benefit of the experience of all managers pertaining to every detail of the apparatus under his control.

12. By means of the comparisons indicated, covering all electrical and mechanical data and all items of expense and income, any manager will be able to show to his directors how the results of the business he is doing for them compares with the results of all similar undertakings. It will give him

the ability to indicate to them unerringly, what changes, if any, must be made in their policy or plant, to enable them to realize the best obtainable results.

13. In furnishing the evidence obtained from the history of his own experience, each manager receives in equal exchange the record of experience of all others. He must be an expert and a wise man who can claim that he will not be a large gainer by such a transaction. Rightly estimated, the gain of each company, from the judicious operation of a proper system for recording and comparing data, will be so enormous, that none, much less the smaller ones, who can least afford to employ highly developed talent, can afford to be without a membership in the organization through which it may be secured.

14. No more pertinent illustration of the value of systematic and organized effort to improve a special feature of the electric industry, can be required than that which is found in the work of the New England Exchange. If the well devised system that has been developed by the workers in that special field can be adopted by the National Electric Light Association as one of its features, that fact alone ought to be sufficient to secure it a membership from every central station company in this country.

THE VALUE OF DATA TO THE USERS OF ELECTRIC SERVICE.

15. The value of economic data to the electric industry cannot be completely stated without considering the interests of the users of electric service.

16. From an electrical or mechanical point of view, the value of all apparatus finds expression in light or power. From an industrial point of view, its value is expressed in the advantages it brings to the users of its service. These advantages are limited by what it enables them to do and what it costs to do it.

17. The advantages of electric service are not wholly under the control of manufacturers of apparatus, nor of the owners of central stations. Their development depends largely on the public policy of the community in which the service is rendered.

If that policy places unnecessary restrictions on the business of the central station company; imposes on its methods of construction, having no foundation in engineering requirements, nor in true considerations for the public safety or convenience; or, if it holds over the company an eternal menace by being willing to grant a franchise to a raiding enterprise, under the mistaken idea that prices can be permanently cheapened by competition, it will pay a righteous tax for its mistakes, in the price of the service it uses.

A comparison of the results of such a policy, with that of a community that intelligently permits construction in accordance with the best engineering requirements and true consideration for the public safety and convenience, that sets itself as firmly against an ordinance permitting competition as it would a declaration of war, cannot fail to educate all users of service to a correct understanding of true economic conditions.

18. In the competition between cities, states and nations, the utilization of the discoveries of science in accord with the requirements of natural economic law, is a more potent factor in securing industrial supremacy than the possession of natural advantages. The day has come when intelligence is master of physical forces. When these truths are properly understood, the users of electric service will demand and enact economic legislation that will secure the interests of the manufacturers of apparatus, the suppliers and the users of electric service, on terms that will enable each to realize the highest economic advantages that can be derived from the perfect development of the electric industry. The advantages of a public opinion so educated should not fail to cause all who can to unite in securing the data on which it must be based.

THE VALUE OF DATA TO INVESTORS IN ELECTRIC STOCKS AND BONDS.

19. The proper construction, equipment and operation of a composite central station designed to supply a community with the foundational necessities for industrial prosperity and domestic comfort and refinement—*heat, power and light*—is an undertaking beyond the reach of ordinary private capital. It is a public improvement, the capital for which must be secured by the sale of the stocks and bonds of the company organized to carry on the enterprise.

20. A central station company must be organized under the state law. It must operate under a municipal franchise. From its birth, through all its existence, it must be subject to the regulation and control of state and municipal legislation. This fact should secure for its stocks and bonds a financial standing equal to that of the best securities in the world. That they are not so held is evidence that there is a lack of data regarding them, and an unwise or unsettled condition of public policy regarding the tenure of their occupation of the field of their operations.

21. In my opinion, the exercise of state authority for the regulation and control of companies organized under state laws to operate under municipal franchises, should be so used as to render their securities as safe and profitable an investment as are the securities of national banks. Both are creations of legislative enactment. Both supply fundamental wants of industrial life. A calamity that would render users of *heat, power and light* incapable of paying their bills for service rendered, would render them incapable of paying their bank obligations. Organized to supply necessities of civilized life, based upon the prosperity of the communities in which they are located, guaranteed by the ability of users to pay for a service that secures them an industrial advantage, there is no economic reason why the securities of central station companies should not be a favorite investment for all who desire *permanency, safety and profit.*

22. Large investors require the greatest certainty and accept the smallest return for the use of their capital. All data and all legislation that tends to secure safety and permanency of investment, will tend to make capital abundant and cheap for central station companies, and thus enable them to reduce

the cost of their service to its users. A community can serve its interests in no better way than to exercise its power of regulation and control, to secure the necessary data to guide intelligently investments in public improvements and its own legislative action.

23. The securities that to-day bring investors the smallest returns are those of the public debt. They represent the destructions of war. This fact does not prove that the destructions of war are of greater service to humanity than the constructions of peace. It proves that a nation, as well as an individual, will give all it has for the preservation of its life. That it may always command "the sinews of war," it cannot allow its credit to become impaired. For this reason, the natural law of self-preservation has quickened man's intellect to devise laws for public finance, designed to give the greatest possible security to investments in government bonds. Next to the duty of preserving life, is the duty to make life worth living. Government will confer its greatest benefit on society when it renders investments in those enterprises which daily supply the necessities, comforts and refinements of life, the best securities in the market. This done, capital, the sinews of peace as well as of war, will flow to such enterprises in abundant supply, and humanity will realize a condition of civilization such as the world has never yet enjoyed.

THE VALUE OF DATA COLLECTED BY GOVERNMENT AUTHORITY.

24. Every ten years, under direction of the national government, a census is taken. The history of the development of the national census among all peoples is the history of their appreciation of the value of data. From the mere enumeration of men able to bear arms, census taking has broadened until it includes all data having a social or industrial interest.

25. The census of 1880 has no section for the industry of generating and distributing from central stations electric service for the uses of light and power. The census of 1890 should have such a section. If the data for it are properly collated and arranged, it will make a marvelous exhibition of the birth and growth of an industry in the short space of one decade. The annals of civilization may be searched in vain for a parallel to it.

26. The data so acquired and published by authority of the national government, will give an impetus to all electric central station service, that will cause the record of the decade from 1890 to 1900 to be one of the transformations of methods of generating and distributing the means of supplying cities and towns with *heat*, *power and light*.

27. In 1900, the electric light will be the light of the present, the operating of street cars by horses will be unknown, and physical labor for man or woman, in all industrial and domestic occupations, will be reduced to a lower minimum than has ever yet been realized.

THE TRUE BASIS FOR THE WORK AND INFLUENCE OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

28. None of the results indicated can be obtained, desirable as they may be, unless they are the results of system and organization.

29. That records may be kept regarding pertinent points only, and with the least work or cost; that the data may be so tabulated that it can be readily understood and compared—a uniform system of records and accounts must be devised, covering all points of interest. To devise such a system and institute proper comparisons for the use and benefit of all station companies, is the direct and most important work of this Association. By doing this, it will furnish a reason for all central station companies to be represented in its membership. Such a membership will give to its deliberations and actions an influence that will have all the binding force of law in some directions, and in other particulars it will so direct public opinion, that laws will be shaped in accordance with its views.

30. It will establish the electrical and mechanical value of all apparatus. It will develop the operation of central stations into the best organized and most reliable service in the country. It will secure the highest possible degree of economy, and the most reliable returns for invested capital that can be found in any industry. In doing this, it will be a large contributor to the material prosperity of the people.

31. The work and influence of the National Electric Light Association must begin in data, they must be sustained by data, they must have for their objeetive point the securing of data.

32. Data are recorded truth.

33. "Commend to the keeping of the Truth whatever the Truth hath given thee, and thou shalt lose nothing."—*St. Augustine.*

MR. FOOTE: Mr. President, to give practical effect to my paper, I respectfully submit the following for the action of the Association:

Whereas, It is desirable that this Association shall collect for the use and benefit of its members complete and accurate data regarding all important details involved in installing, operating, maintaining and administering the plants and business of central station companies,

Be it Resolved, That a Committee of five be appointed by the President, to report at the next Convention of the Association, forms and a system of records and accounts, to be kept by central station companies; a system for reporting the same to the Association, and for comparing and publishing the data so secured for the use and benefit of the members of the Association.

The motion was seconded by Mr. Brown.

THE PRESIDENT: The paper is now before the Convention for discussion.

MR MORRISON: Mr. Foote is engaged in a work that almost every one has neglected, and yet without which work we would probably never be able to conduct the electric light business successfully. It is the true channel through which information should come. If you can once get down to the point where men

will come into the National Electric Light Association, and state in plain terms their plans and their methods, and the result accomplished, then you will have gotten to the point where the original idea of The National Electric Light Association can be carried out. Mr. Foote is on that track. I believe I am doing him scant justice when I say that he has spent more time and more money in the service of The National Electric Light Association during the past 12 months than any other man in it, from its President down to the last man on the Board. (Applause.) I think that such work should be appreciated. I believe it will be appreciated, and I think in the end appreciated in a substantial manner to Mr. Foote.

I do not desire to take up any more of the time of this Convention than I can help. I made a promise to myself and some of my friends that I would not talk in this Convention. But it gives me a great deal of pleasure to second Mr. Brown's motion to adopt this resolution, and it was for that purpose I rose to my feet.

THE PRESIDENT: You have heard the motion. Are you ready for the question? (Cries of "Question.")

The President put the resolution, which was carried.

MR. MORRIS: I believe this is the second meeting of this Convention that I have attended and, as a member, I can say that I am glad to come and get the new kinks and points from others, and get practical benefit from them. We have had a representative, I believe, at every meeting, and I have attended two or three of them myself. But it has been an unsatisfactory thing to me. I have come to these meetings, and my manager and my superintendent have come. We come here and go away not feeling exactly that we have got what we came for. What we wanted was new points; practical points. We have come here and heard a great many theories upon electric light matters, and all that sort of thing, but that was not what we wanted. We had a committee here at one time to consider which was the best wire. I tried at one time to get a report out of that committee, but I could not do so, and nothing practical was done. Now, Mr. Foote's paper seems to me striking out in the right direction—to get at the practical, to get at things that will benefit local electric light men. That is what I am here for, represent-

ing that sort of an interest. While I don't believe that it is hardly practicable to get this data, such as that resolution calls for, and while I believe that very few companies are going to disclose their private business, show us exactly what they are doing, and all that sort of thing, yet perhaps they will be willing to tell us something about the operation of their machinery, how it is produced, what is the effect, and such as that. If I am asked what is the best lamp, I don't hesitate to say. But I think that perhaps we can safely risk this Convention, composed of members from different electric light companies, to express itself in behalf of a measure so evidently for the benefit of us all. I do not mean to say that we are going to ascertain so many practical things, because it is natural that everybody who is operating a plant is going to stand up for his kind of machinery; if he is running a Thomson-Houston, he is not going to say that something else is better, and we cannot hope always to get at the true inwardness of the thing; but we can get something in that direction; and if we follow in the line of Mr. Foote's paper, I think there is a better future for this Association.

MR. DE CAMP: Mr. Chairman, in regard to Mr. Foote's paper, I think he has made some suggestions which will bear looking into a good deal more closely.

Like Mr. Morris, I attended the first meeting of this Association, or the third one rather, at Baltimore, for the very reason that he states. At that time there was considerable money invested in the electric light business, and more money being invested, and its main objects seemed to be then to find out how to properly invest the money that was being called in to this electric light business. The methods of the Association then were crude and, if I recollect right, did not take the form of reading papers. Every member got up and said what he felt like saying, and generally spoke pretty well to the point; consequently, there was a great deal more talking done than there has been in the late meetings. The result was that I believe that the second $100,000 invested in Philadelphia was invested better than the first. The first was invested on a good deal of guess-work; the second was invested on some knowledge, partly gained from the experience of investing the first our-

selves, and what we later had the opportunity of observing that others had invested.

Now, we have had a great deal of money invested—not that there might not be more—but another thing comes in, and that is to make the most out of what we have got invested—to make the most returns out of it. I think that one of the most beneficial things growing out of this Association is to do away with the prejudice existing among the different systems. At the first meetings an advocate of the Brush system would not dare open his mouth in favor of that system to a man representing another system, and *vice versa*. That is now done away with. No one hesitates about expressing himself now; in fact, there is so much information all around, it is pretty risky for a man not to tell the truth. But still, at the same time, there is a sealed book existing among the electric light people, and the resolution that has been offered covers it. I know of companies that are operated and that are deceiving themselves both ways. This I know of my positive knowledge. Some are deceiving themselves with the idea that they are making more money than they really are; they think they are making money when they are really not making a dollar. There are others that think they are making nothing, when they are doing very handsomely. It is my misfortune to be interested in companies of both characters; it is a very unfortunate position to be in. I have had to stand up and make statements and rely upon my word being accepted, upon matters in which my statement was the only evidence I had to offer of their truth; I mean abstruse subjects, and matters on which they were entirely skeptical. They had only my say-so, and if they were skeptical on the first statements I made, they were skeptical on the second. But if we had matters in this Association in such shape as contemplated by this resolution, every manager of a company would feel very much stronger; he could present his business to his Board of Direction with a good deal more force.

I appreciate that it is a very difficult subject to deal with, but still, at the same time, I do think that it can be got in such shape that a report can be made without in any manner or form revealing the private affairs of any particular company. I think that is entirely possible, but the greatest difficulty is to get the

companies to appreciate it, because it is going to involve the complete changing of the systems of some of the companies. It is true that a great many do not have any particular system. I have known cases of that kind, but still they think they have; and they are going to be required to change them very radically, and that is going to be the difficulty in carrying that resolution into effect. But there is no doubt that there is a great deal of information that is needed among the electric light companies. This is going a good ways—to say that people do not understand their own business—but there are some things about my own business that in a self-satisfied way I think I understand; but, at the same time, down at the bottom of it, I am very doubtful myself.

Mr. H. F. Coggeshall (of Fitchburg, Mass.): In the general management of electric light plants, I find that they make no money, and as it was stated that this paper would be on the economic data, I was in hopes that the gentleman had already discovered a method by which he could show me how to run an electric light plant and make money out of it. Of course, the plant which has been operated by our old company was put up in a way that it was impossible to make any money, and they are now erecting a new station. I do not see any difficulty at all in getting information, without detriment to any company at all; data, for instance, in relation to the coal, the kind of wire used, the durability of the circuit, and various other matters that would be profitable to every member of this Association. I belong to the gas fraternity, and I have always attended every meeting, and when I found any one else doing any better than I was, it only set me to work to come up to it. That has been my point, and I am satisfied that there can be money made in the electric light business. These statistics, as far as we have got any, in the State of Massachusetts last year, from 75 or 80 companies, showed that there was only five of them carried a credit to profit and loss account; so that the whole thing depends upon the commercial value of running an electric light plant; and it is the data that we want to be guided by regarding their operation.

Mr. Whipple: I may be pardoned, perhaps, if I say that I know something about collecting data. I have spent about

$5,000 this year in collecting data. Under the present organization of the Association, there are certain matters connected with the operation of the central electric light station that no association nor no amount of private capital could get; yet, it is just that information that is of benefit to the man next door to him—the number of dynamos that a man has in his station, who his engineer is, and who his superintendent is, are of no practical value whatever. The economic principles of that station you never will be able to get, and if we should get such statistics it would be the height of folly, it seems to me, to publish them for the benefit of this Association, because the members of this Association are not, by any means, a close corporation, but are the general public. As far as that is concerned, we are not bound by any oath to keep to ourselves anything that is told us. These circulars, I take it, would be a private confidential circular of information regarding this, that and the other stations, but I don't see how you can go to work and practically get at this information. You can't convince a man that is running a station whether he is or is not making money; if he is making money, he is not going to tell you how much he is making. And therefore, I should like to see this resolution embodied in the proceedings of the Convention in a somewhat different form. Before we take the step of forming a Committee to do something that on the surface is clearly impracticable, I think that we ought to give more than a cursory glance at it and find what we can get, and then, after we have got it, find out how we can disseminate it, and who we will disseminate it to. I am not, and never have been, an operator of a central station, but I take a good deal of pride in gathering data, and I don't like to see the Record of the Association cumbered up with a lot of so-called dead letter resolutions, which never amount to anything, and which never will in the present state of things. If we are going at this thing, let us go at it in a way that we can get some profitable result therefrom.

MR. DE CAMP: There are certain essential costs in the operation of an electrical station. So many matters of judgment enter into the question of costs, you cannot tell what a thing costs without going into the whole details. To illustrate, it is not necessary to say what the lights in this plant or in that plant

costs, or what they are selling for. That is private property, which I do not feel like spreading before this Convention; but a man comes to me to-day and says, "My lights actually cost me 15 cents a light." Another man says, "My coal only costs me so much." Now, both of those gentlemen may be right in their conclusions. You cannot draw any comparison between these two men, because you do not know how they arrive at the figures. Now, if you will formulate a system of keeping those accounts uniform in all the companies, you will have them arrive at those conclusions by precisely the same method. Therefore, if a man says my coal costs me 15 cents, and another man says his coal costs him five cents, you come right together on the floor of this Convention. Any one who differs from me can go to that particular point. We are both using the same method of coming to these conclusions, but are entirely different. Let us see where we differ. Now, you bring it down to some particular point. It is a waste of time to make the comparison unless you arrive at all results by precisely the same method. It is the same thing as was here stated about the finding of the cost of coal. Some coals are better worth four dollars a ton than others are two dollars, and yet frequently the engineer says, "I am getting results of so many pounds of coal to the horse-power." It don't mean anything. It is a question what kind of coal you use—if screenings or clean, hard coal, etc. There is the explanation of it. That is where the value of this report will come in; and I gave some consideration to this subject several years ago. I did think that we could arrive at it by a system of percentages, or something of that kind. I think that can be arrived at. If time permitted it—I see the Chairman has me down for remarks on a kindred subject—and I think if we devote the time to it, that we can arrive at some good method of doing that very thing, and I told you gentlemen when you do it, I am prepared to say now that a certain part of our work is run the best I know how to do it, and I am not satisfied, and if I can find any other manager who is doing it better than I am, I want to know how he does it. I heard, over and over again, of these things being done with better results than I do them, and it stops right there. I am entirely unable to find out from that party how he does it.

THE PRESIDENT: The Secretary has telegrams for W. H.

Lawrence and John Haskins. Is there any further discussion of this subject?

Mr. Morris: I am in favor of that Committee being appointed, and I believe it can do some good. They can formulate some of the questions that may be of value; for instance, the gentleman here at my right has asked me a number of questions about my station. I know they could be put in the shape of questions and sent over the land, and their answers would be satisfactory to me, and I am willing to risk the intelligence of that Committee in formulating the questions for central stations to answer.

The President: If there is no further discussion, the topic will now be passed. We will now hear from Mr. M. D. Law, of Philadelphia, on the Theoretically Perfect Arc Light Stations.

At this point a number of gentlemen arose to leave the room, when the President said:

Gentlemen, please keep your seats. This is a practical paper, which contains information that I know many of you came here to get.

Mr. Law then read his paper, as follows:

THE PERFECT ARC CENTRAL STATION.

BY M. D. LAW.

It has usually been more the rule than the exception that electric light central stations have been located in almost any place that could be had; some old shell of a building would be used, that would have nothing to recommend it, except that it was cheap.

In fact, the first station for central lighting purposes was started in San Francisco in a blacksmith's shop, using an old, worn-out, portable engine and boiler. The force consisted of one man, who was superintendent, dynamo man, engineer, fireman, trimmer, inspector and lineman; but the price received for the lights would gladden the hearts of the electric light companies of to-day; they were ten dollars per week per lamp, and burned from dusk to midnight, except Sundays. And when I look back to that time of running arc lamps on one wire, with ground return, I am amazed that there were so few troubles in the shape of grounds and fires. Not only was a ground return used, but inside wiring was thought good enough when put up without any insulation, but fastened with wire staples.

There are a great many places, even now, where bare wires are stapled fast, showing the absolute need of good, competent, fearless inspectors, who will examine every inch of wire in a building, and not be afraid to condemn it if

it does not come up to the requirements of safety. Then, again, all inside wiring should be inspected at least once a month.

An electric lighting station should be located as near the center of the territory to be lighted as possible, but if sufficient ground cannot be obtained at a reasonable cost, then it is better to go a little to one side rather than be crowded for room; for when an electric lighting station is cramped for room, it cannot be handled with economy, as one of the greatest successes of central station work is not only in the simple running of the machinery well, but, when troubles occur, in the shape of breakdowns (which are liable to happen in the best regulated station), there should be sufficient room to move the machinery, without taking too much time. In such a case time is money, for the amount of money allowed in rebates is only a small fraction of the loss, as the reputation of never having the lights out is worth much more than their mere money value. For electric lights are not a success until they can be placed in business houses and halls, having no other method of illumination, without danger of their being suddenly left in darkness; rather have the machinery and lines in such shape that the lights can be depended upon at all times. This may take a little more money for the construction of the plant, but it will be more than made up in the commercial value of the lights.

An electric lighting station should be built of brick or stone, in a neat, substantial manner, not more than two stories high, and be as nearly fireproof as possible. One of the important factors of such a station is good ventilation, it being necessary to keep engines, shafting and dynamos as cool as possible. This not only adds to their life, but their over-heating is a great element of danger to the success of the lights.

BOILER ROOMS AND BOILERS.

The boiler room should be located on the ground floor, with plenty of ventilation, making the fire room cool and comfortable. Everything being in full view and easy of access, can be kept clean and in order.

In constructing an electric light station, the dynamos and engines are generally placed first, and what room is left the boilers are thrown into, without much regard to their economical handling. It is better to have a comfortable fire room, as the firemen can then remain by the boilers, doing justice to their work. By having boilers in cellars, cramped or poorly lighted and ventilated places, it makes the men careless, and also detracts from the life of the boilers by corrosion and improper care.

It is found that two-thirds of the steam which is generated in a tubular boiler is made on the shell, and not in the boiler tubes, as supposed. In taking the heating surface of boiler tubes we should only take one-half of the circumference, as the flame only impinges on the upper half of the tubes. With proper setting, flame can be carried the full length of a 30-foot boiler, with ordinary natural draught, using secondary combustion. Automatic dampers should never be used; by their use it is impossible to get proper combustion, as they are either open or closed, besides having the

tendency to make firemen careless. An ordinary fireman, with hand dampers, can fire with not over two pounds variation of steam in a run of twelve hours. When the boilers are working to within three to five pounds of their utmost capacity, the hand dampers are kept partly open, and as the steam varies, the damper is changed to suit, therefore, always allowing of proper combustion.

For a 1,000-light station there should be 12 single tubular boilers, 48 inches in diameter and 20 feet long, with 22 five-inch tubes, the shell to be made of ⅜-inch steel or iron, having a tensile strength of 55,000 pounds and 25 per cent. ductility in 8 inches.

Double riveted longitudinal seams and first-class workmanship will stand a safe working pressure of 130 pounds per square inch, which will give 1,325 horse-power. With the Corliss type of engine carrying 110 pounds per square inch, there would, therefore, be three boilers, which could be held in reserve, that being none too many for safety, and the other nine boilers can be worked very easily, as rapid combustion is the most economical.

ENGINES.

Electric lighting is one of the hardest kinds of work for a steam engine, the continuous running and the work being thrown on and off instantaneously, causing immense strains.

They should be twin engines, connected at right angles, by which we have steadier power than with single engines, because we have the impulse of the steam at every quarter of a revolution. They should be built specially and have a larger amount of iron in all their parts than is used in an ordinary commercial engine, so that in times of trouble they can be forced for a short time beyond their ordinary load.

For a 1,000-light station there should be two 23x48-inch twin engines, running at a speed of from 70 to 80 revolutions. With this number and size of engines there will be a reserve of one engine, as the three engines will easily carry the load of 1,000 lights with economy.

It is a settled fact that the Corliss type of non-condensing engines, properly constructed and handled, are the most economical, using less than two and one-half pounds of coal per horse-power hour, working at 110 to 115 pounds of steam per square inch. High rotative speed is not necessary for electric lighting, but it does require a steady and uniform speed. An engine running 40 revolutions per minute, provided the speed is regular, will make as good lights as one running 300 revolutions.

It has been practically demonstrated in a great number of plants, which have used the small, high rotative speed engines, that such is the fact, the low speed using less coal, oil and attention, while the cost for repairs is very much less, as well as loss of steam from radiation, clearances, etc., than high speed engines. On a pair of Corliss engines, 23x48 inches, at 75 revolutions per minute, running day and night for nearly seven years, the actual cost for repairs was but $25, and during that time they were shut down but once on account of breakage, and then only 10 minutes to disconnect one engine, the other being run with the load of both at increased steam pressure.

SHAFTING.

The friction of a high rotative speed engine and a 60-light dynamo is six indicated horse-power, while the friction of one pair of engines, shafting, 22 empty dynamos, 11 idlers and 22 Hill clutch pulleys, five feet in diameter and 12-inch face, is but 72 indicated horse-power, both running up to speed. The only argument against large engines is that in case of breakage it stops the whole plant, whereas in a series of small engines, connected direct, it will stop but one dynamo.

In all cases shafting should be made of hammered iron, and for a 1,000-light station the main line should be 75 feet long and six inches in diameter, and about 55 feet of counter shaft, commencing at five inches diameter and reducing one-half an inch for every two machines, to be located on the ground floor, with pedestals as low as possible and bearings of cast iron, not less than four to one. The main bearings ought to be of phosphor bronze, and the shafting run not less than 300 revolutions per minute. The expense of oil on such a shaft, with proper appliances, will not be over three dollars per year.

The driven pulleys from the engines should be on the two ends of the main line of the shaft, with a clutch cut-off between one engine and the first dynamo pulley, one between the last dynamo and counter pulley, and one between the counter pulley and the other engine, with a clutch on the counter pulley. This will give perfect control of the main shaft and counter shaft, and can either run one or both engines, as the load may require.

DYNAMOS.

The dynamo room should be directly over the shaft lines, so as to use angle belts. The light should be good, and the ventilation perfect. The roof should be supported without posts, and be of sufficient height so that the dynamos or armatures can be hoisted and carried over the ones that are running. Insufficient room overhead is a great drawback to the successful handling of electric light machinery.

The dynamos should be small and mounted on cast iron beds, left entirely open to allow perfect cleaning, as the life of dynamos depends very much upon their cleanliness. They should be placed in rows, with sufficient space between them to allow easy access to all of their parts, as well as ample room, that they may be moved from one part of the room to another without disturbing those that are running.

If the roof cannot be made sufficiently strong to support the combined weight of dynamo and armature on a track, then a good substitute is a frame supported on large casters, with a track over the top, having on it a chain geared trolley and a chain hoist. This will allow of the rapid lifting of the dynamo, its moving to some other place, rolling the hoisting frame to that place, and putting the dynamo in proper position for running. With this arrangement a three-ton machine may be moved and put in running order in 30 minutes, requiring but four men; with a little longer time two men will do the same work.

A cupola should be provided, not smaller than 10 by 30 feet, and 10 feet high, with window ventilators extending the full length of the two sides, and so arranged as to be under the full control of the machine man. With such a cupola, one is enabled to put the lines in good shape, as well as to carry off a large amount of heat. The wires should run to the switch board from binding posts placed through the center of the cupola, and all crossing of lines should be made at this point.

SWITCH BOARD.

The switch board should be placed in the middle of one side of the dynamo room, and four feet from the wall, and should be at least 25 feet long, which will give room for 50 circuits. As it is impossible to keep all circuits built up to the full capacity of the machine, it is well to have a number of small circuits to couple in, in order to build up to the full machine capacity, as all dynamos work more economically with a full load.

The line wires should come into spring jacks, which are arranged in two rows, with one side of the circuit on top and the other below, with eight inches of space between them, so that there is no possible danger of a person being liable to touch or short circuit two of them. Before attaching to the spring jack, one side of the circuit should pass through an indicator for showing the direction of the current. The wires from the dynamos should be run beneath the floor, coming up on the back of the switch board, and enter binding posts, to which a flexible cable should be attached, having a wooden-handled plug for entering the spring jack; these cables should be of sufficient length to reach either end of the switch board. The spring jacks and binding posts of the machine cable should be so arranged that a connection cable can be hooked on for the purpose of moving the machine cable from one circuit to another, to cut out or cut in circuits, without extinguishing the lights already burning. The positive wire coming from the dynamo should pass through an ammeter before entering its binding posts.

A good arrangement for making ground tests and locating grounds while lights are burning is a set of thirty 92-volt incandescent lamps in series, so arranged with a circular switch that any number may be short circuited at will. With one side of this lamp circuit connected to ground and the other side connected to the line to be tested. a ground on the line will show by one or more of the lamps burning.

I find that with the lamp burning on, say, the positive side of the test circuit, with an electromotive force of 92 volts, the ground may be looked for between the second and third arc lamp on that side of the circuit; in fact, each 92-volt lamp will represent two arc lamps or their equivalent in line wire resistance. This is a simple and handy method of locating grounds, especially if the positive and negative side of the circuit are much separated, for it starts one out on the right end of the wire, which is rarely the case, without some reliable method of testing. When two grounds occur at night, cutting out a number of lights, it is necessary to be able to start out with

some knowledge of its locality, especially if such a circuit is from 12 to 15 miles long, and starting out from one point of the compass and returning by another.

If there is an indication that the full number of arc lamps are not burning on a circuit, by attaching one side of this test to the positive and the other to the negative spring jack of the circuit in doubt, it will show within one or two lamps of the number that are burning.

Ammeters, lightning arresters, indicators and all connections should be placed on the switch board.

LINES.

Lines in all cases should be supported on glass or porcelain throughout their whole length, and should never enter a building without passing through hard rubber tubing with water drips on the outside. In all cases, inside wires should be run on glass or porcelain insulators; moldings or cleats should never be used for arc light wires, and in no case should they be put under floors or out of sight.

All arc lamps should be hung on porcelain insulators, and in the case of outside lamps all iron should be galvanized to prevent the rust from collecting on the insulators, which gives a first-class ground, if the fixture connects to tin gutters or iron work.

All lines should be tested for grounds at least three times during the day, and once every hour while the lights are burning; as soon as a ground occurs it should be immediately found and cleared.

STORE ROOM.

The store room should be of good size and provided with cupboards, drawers and shelves, that a full line of all supplies can be kept on hand and issued only on requisitions from foreman of construction gang. When a job is completed a return should be made of the material returned and the charge entered in the proper books.

A carbon book should be kept in which each trimmer signs a receipt for the carbons issued each day, as the trimmer reports each day the number of carbons used on his route. The stumps returned must accord with the report at the end of the week; he must account for the number of carbons on hand or pay for them. The trimmer will only pay for one lot of lost or broken carbons, as he finds it easier to take care of carbons than to buy them.

SHOP.

The shop should be of good size and provided with at least one 12-inch lathe, drill press and buffing wheel, with sufficient small tools for all kinds of repairing and the manufacturing of switches, fixtures, insulators, and all the thousand-and-one articles that come up for use in such a station.

The test rack should be located in the shop and be large enough to hold at least four lamps, each lamp to be provided with an adjustable lens for focus-

ing the arc of a lamp on a screen; this affords a good opportunity of closely watching the arc without injury to the eyes, and has a capacity of from seven to ten lamps per day.

GENERAL.

A record book should be kept at some convenient point in the dynamo room where it is accessible to all of the employés. In it should be kept a correct record of all that happens about the station, as well as inspector and trimmers' reports.

There should be a circuit board, on which is recorded the number of the circuit and machine, with the time of going on and off. Whenever a ground occurs it should be plainly marked on the circuit board and erased when cleared, that all men may see it and be warned. When lamps are put on or off they should be marked up on the bulletin board, giving the location and number of circuit, that trimmers and inspectors may know of the change before starting out to their work.

The foreman of construction should make a written report, on properly arranged blanks, of all new lamps and lamps discontinued, when they will be marked up on the bulletin board and properly entered in the circuit book; he will also make written line report each day, that the pole diagrams and circuit route book may be correctly kept, the latter is very important in order that in case of trouble at night you are enabled to quickly tell the route of any circuit, no matter how recent the change.

The men should be divided in gangs with properly instructed foremen over each. In a 1,000-light station one man is sufficient to do all cutting of lines; and such work should at all times be done by this man, as you can then choose a careful reliable man who can have the special instruction necessary for such work. This very much reduces the danger.

A reading room should be provided accessible to all of the men, in which should be kept a good library of electrical and scientific works.

There should be a meeting of all men not on duty, at least once a month, at which time a paper or some article from books or periodicals should be read for the purpose of discussion and demonstration. This also gives the superintendent a good opportunity of explaining difficult points and to give the men the training that is necessary to keep up with the rapid advancement of the science.

I have conducted a series of such meetings for about two years, giving a lecture to my men at each meeting, and I find that the men who have attended regularly are becoming well posted and do their work better and quicker than those who do not give the meetings regular attendance.

MR. MORRISON: Will you please read again, Mr. Law, that paragraph relating to the running of the engines?

Mr. Law then read the paragraph stating that two Corliss engines in his station have been run for seven years at a cost of

only $25 for repairs, and that then the only time lost was ten minutes for disconnecting from one engine to the other.

MR. MORRISON: Is it possible that you ran your engine for seven years?

MR. LAW: Yes, sir; for seven years. They were stopped about an hour each morning and on Sundays.

MR. MORRISON: It is a very remarkable performance. Have you been familiar with any other engines than the Corliss?

MR. LAW: Yes, with the Porter & Allen and the Buckeye, about 100 horse-power.

MR. MORRISON: If these statistics are true, they are very remarkable; if they are not true, they are very misleading. Gentlemen who have had experience in this matter, it strikes me, should ask questions about it to see if it is an error. The performance of these engines is so remarkable. I have never heard of such a thing.

THE PRESIDENT: The paper is now before the Convention.

MR. MORRISON: Were they run by one engineer all of the time?

MR. LAW: Yes, the same chief engineer had charge during the whole seven years.

MR. MORRISON: The description Mr. Law has given of an ideal station is a description of his own station. (Laughter.) It is a very fine station and it is an infinite credit to him, but I cannot imagine how an engine, such as the one in the Philadelphia station, could run for seven years without stopping—the paper says run continuously—they never stopped but once, and that was on account of a break-down.

MR. T. CARPENTER SMITH (of Philadelphia): I think this is one case Mr. Foote's paper would cover. Mr. Law states that the engines have only cost $25 for repairs. I would like to ask if the engineers, when the engines were shut down, have not done a good deal of fixing up, keying up, putting in packing, etc., which has not been charged up. On the other hand, I understand Mr. Law has a first-class mechanical engineer, who is a sort of consulting engineer, and whose advice or time ought to be charged to these engines, because I am very well satisfied that engines of that type cannot be kept up to such a remarkably good record—as I know those engines have—without care

of a kind which, while it often seems to be more expensive, is often the cheapest in the long run. The $25 that he counts for repairs, I presume, are outside repairs, as $25 for a new set of brasses or something of that kind. We had one, 24x48, that cost us $11,000 for 11 months' run.

MR. MORRISON: We have some Corliss engines, and while they are good evidence, their result is nothing like that. We have quite a large lot of Buckeyes which give excellent satisfaction. We have also Ball engines, tip-top engines, giving the very best of satisfaction, and costing very little for repairs. But they have stopped several times in the last six or seven years. The Corliss engines, as now erected, are the worst of the lot.

MR. S. S. LEONARD (of Minneapolis): I would like to state, in behalf of the Corliss engines, we have been using one for nearly five years, and one of those engines which we have recently taken down to make room for a larger one, ran four weeks continuously, day and night, 24 hours in a day, without shutting down, except for general repairs and tightening up—some little matter—nothing the matter with the engines. It ran continuously for four weeks, and those engines, outside of packing, which everybody knows will wear out more or less, have not cost more than $25 for repairs.

MR. DE CAMP: I think Mr. Morrison is right in saying we want facts. Now, facts are sometimes deceptive unless we understand thoroughly all the conditions which surround these facts. It is true that the pair of Corliss engines referred to by Mr. Law did run seven years; they ran continuously—we had nothing else to run—for an average of 22 hours a day the year around, with the exception of Sunday, when they shut down about the usual time in the morning and started up in the afternoon. They rested eight hours on Sunday. What Mr. Law means in his statement is this, not that we did not incur the expense of having them well taken care of, nor that they were not subject to a certain amount of wear and tear. When he says $25 he is outside of the mark. That $25 grew out of the breaking of a dash-pot rod; but these are extraordinary conditions. They were put in there as 24x28; the cylinders are bored out at 23. Every part of the engine was made from a pattern one size larger; consequently, we are running a Corliss engine 23x28,

built on 26-inch patterns. The foundations of those engines cost, I think, about $2,600 or $2,700. Now, I say this. I approved of the specifications for that engine. I approved of the specifications for the foundations against the judgment of the builder, but did it on this basis: The chief engineer says he wants to do this—that is what he expects. For instance, the specifications were made for the foundations; one of the requirements was that they were to be of a certain size; they should be hard brick, laid in pure cement. The lowest bid was, I think, some $2,600. It was from a man who had very large experience in building engine foundations, one of the best we had in Philadelphia. He came in and made his estimate. He started in and laid two or three courses of brick. The engineer said: "Stop, the specifications call for pure cement." "Well, this is pure cement—a certain portion of cement and a certain portion of sand." "But I want pure cement." "Do you want absolutely pure cement?" Well, the contractor says, "I understand this thing the way we generally term pure cement, but what you mean you want is that every brick shall be dipped in absolutely pure cement?" I said, "I do not think it is just the proper thing to take advantage of some individual construction of the engineer," and I called him in and said, "Now, do you mean exactly what this says?" Yet, in his judgment it was necessary, and he said: "We want those foundations that way, and want that engine to stand and don't want any after-claps about it." I said: "Then we will have to have it." That contractor told me he never built such a foundation as that before in his life. The borings, as I said, those were all one size smaller than the engine called for. Now, in point of fact, there has never been a movement in that engine.

Another thing; we have followed the rule of using first-class oil; I think we are paying 90 cents for cylinder oil, and 40 or 45 cents for machine oil for the bearings. The time we shut down, it was due to a hot crank requiring adjustment. That part of the expense was not charged for. It was done by our men—by men that we were paying whether we had them at work or not. It is only now that the chief engineer makes a suggestion to me, if he could get a chance to shut down he would like to have them bored out; not that he thinks it is

an absolute necessity, but he thinks the time is coming when we will have to do it. But the success of these engines is due to the fact that they were well built in the first place—well bedded, and that they have had good care, for which we have had to pay.

MR. SMITH: Then you do not consider that it is due to the fact of their being Corliss engines, at all?

MR. DE CAMP: Well, I am a Corliss engine man. I do believe this: That you want a Corliss engine in the hands of a Corliss man. That is certain, and they have said to me, "you must have a man to run a Corliss engine, who understands a Corliss engine—who is in love with a Corliss engine." Now as to the cost—I did not mention the fact that we painted the engine. (Laughter.)

To come back to the Buckeye engine; we have two Buckeye engines, 18x36. In the first place, the Buckeye engines that we ran for five years were run on an entirely different principle from what we were in the habit of running engines. They were run just as long as they would run. The consequence was, that when the time came, they made a bad break. When I take a given number of dynamos and run them on one type of engine, and they consume a certain amount of coal, if I shift them on to another type of engine, and everything else being perfectly identical and they use an excessive amount of coal, the one using the smallest amount of coal I call the most economic engine. We ran one season and then put in Corliss engines. It was necessary to run them hard, and we put in the old type of Brush machine, 40 lights. They did their work all right at 285 revolutions, 100 pounds of steam, 8x16. Now, we changed the type of machine to a 60-light machine. That was more of a load than the engine was equal to. We have never run more than 50 lights successfully, and did that by speeding the machine to 300 and carrying the same amount of pressure. We found out that there was economy in the Corliss engine, and further, it was a reason for dispensing with the Porter & Allen and substituting a Corliss, or some other larger engine.

MR. MORRISON: What difference do you make in your load, in changing that machine?

THE PRESIDENT: I very much dislike to interrupt this discussion, as it is a very important one, and I would like to ask

some questions myself. I would like to know how you run a year on three dollars' worth of oil, and other questions, but as this topic will be continued in the morning under the head of An Ideal Station, from an Electrical and Mechanical Standpoint, by Mr. Marsden J. Perry, of Providence, and Mr. John T. Henthorne, of the same city, I think we can very well bear these points in mind and carry them over, and let us then have a general discussion that will end the matter.

Before stating that a motion to adjourn will be in order, I want to announce for Mr. Foote, the chairman of Committee on State and Municipal Legislation, that his Committee will meet to-morrow morning at 9 o'clock, in Parlor A, of the International Hotel.

I will also announce the following Committee on the World's Fair: Dr. Otto A. Moses, of New York, chairman; E. T. Lynch, Jr., C. J. Field, Fred Gilbert and J. F. Morrison, assistants.

As a Committee on Electrical Statistics——

MR. MORRISON: I wish very much that you would put another New Yorker on that Committee.

THE PRESIDENT: I think I have the right man. I trust you will not withdraw.

MR. MORRISON: I suggest Mr. Phelps.

THE PRESIDENT: I am sure the Convention will bear me out. (Applause.) That settles it, Mr. Morrison.

As a Committee on Electrical Statistics, the Chair would announce Mr. A. R. Foote, of Cincinnati, chairman; assistants: Mr. A. J. De Camp, of Philadelphia; S. A. Duncan, of Pittsburgh; E. F. Peck, of Brooklyn; S. S. Leonard, Minneapolis.

MR. DUNCAN: Mr. Chairman, I desire to have my name withdrawn from that Committee. Statistics are not altogether in my line, and I shall not have time to assist in that matter, and I hope you will substitute somebody else.

THE PRESIDENT: I trust, Mr. Duncan, you will serve. You have had a great many years' experience.

MR. DUNCAN: I have spent a great many years and have a great many statistics, but at the same time I hope you will select some younger blood, some one who will take an active interest in collecting his statistics.

MR. RHODES: Mr. Chairman, is the motion to adjourn in order?

THE PRESIDENT: Yes.

MR. RHODES: Before making such a motion I wish to state as to the excursion this evening; it is necessary for those who wish to attend to be at the Central Depot at 7 o'clock, sharp. I hope every one will go, and that they will be there on time. Those of you who have heard the notice please let every person you see who does not hear the announcement, know about it.

On motion, duly seconded, the Convention adjourned until 10 o'clock to-morrow morning.

SECOND DAY'S PROCEEDINGS.

FORENOON SESSION, WEDNESDAY, AUGUST 7TH, 1889.

THE PRESIDENT: The Chair will appoint Mr. Francisco a committee of one to go into the lobby and stop the machines from running and call the gentlemen into the hall.

We will now hear the report of the Secretary-Treasurer.

Secretary Allan V. Garratt here read the Report of the Secretary and Treasurer, as follows:

REPORT OF TREASURER AND SECRETARY.

NEW YORK, July 31, 1889.

RECEIPTS AND DISBURSEMENTS.

Cash balance from last report	$3,003 82
Dues received from 76 members	1,520 00
Sale of printed matter	2 00
Received from Ex-Treasurer W. H. Harding	299 73
Total Receipts since last report	$4,825 55
Expenditures as per accompanying vouchers approved by the Executive Committee	3,728 62
Balance, cash on hand	1,096 93
	$4,825 55

The present indebtedness is $259 60 which is part of the funds advanced to the Association by Ex-President S. A. Duncan.

The expenditures since the last report may be classified as follows:

Bills incurred previous to the Chicago convention................	$1,483 82
Salary of secretary and treasurer, six months..................	999 96
Clerk hire, month of February..............................	40 00
Postage..	127 96
Stationery and printing (not including the official proceedings)....	234 03
Printing the official proceedings............................	334 26
Official stenographic report of Chicago Convention...............	161 25
Rent of office..	157 50
Advertising in eleotrical journals............................	55 00
Expenditures not specified above	131 84
	$3,728 62

It will be noted, from the Official Record of the New York Convention, that the account of the ex-treasurer called for a cash balance of $1,935 23, whereas the present treasurer has received only $299 73.

The treasurer would here state that he has received from the Executive Committee vouchers covering the difference between the above amounts. He has also received from ex-Treasurer Harding $34 25, which did not belong to the general funds of the Association; but was donated by members to the Committee on Patent Legislation. This sum has been turned over to the chairman of that committee.

MEMBERSHIP, INCOME AND EXPENSES.

The number of members in good and regular standing on February 19, 1889, as per official report accepted at the Chicago Convention, was 175; new members since that date, 76; making a total membership at present of 251.

Of the membership as it now stands, 55 per cent. has been added the last year, 30 per cent has been added the last six months. Making a net gain the last year of 122 per cent; the last six months of 43 per cent.

The annual income of the Association is $5,020 00. Its running expenses for the last six months, were $2,241 80.

Attest: P. H. ALEXANDER, Chairman Finance Committee.
ALLAN V. GARRATT, Secretary and Treasurer.

THE SECRETARY: This is the report up to the first of this month. Since that time the Treasurer has taken in several hundred dollars. I have in my hand the vouchers covering the expenses enumerated in the above account. I have in my hand a certificate of deposit in a National Bank of the balance of $1,950.

THE PRESIDENT: The report of the Secretary and Treasurer is now before you. What disposition will you make of it?

On motion, duly seconded, the report was received.

THE PRESIDENT: Is Mr. Henthorne in the room? Mr. Henthorne not being in the room, we will now hear from Mr. P. H. Alexander, Chairman of the Committee on Harmonizing the Electrical and Insurance Interests.

REPORT OF THE COMMITTEE ON HARMONIZING ELECTRICAL AND INSURANCE INTERESTS.

BY MR. P. H. ALEXANDER.

Mr. President and Gentlemen:

At the February meeting of your Association, the following resolution was offered by Mr. J. F. Morrison, of Baltimore, and was carried:

"That a committee of five be appointed, with P. H. Alexander as chairman, to recommend some means that would secure to the Electric Light Association the advantages now enjoyed by the New England Electric Exchange, regarding the pleasant business relations between the electric interests and the insurance interests, and report at the next meeting of the Association." This motion was offered by Mr. Morrison, in consequence of a paper read by Mr. S. E. Barton, of Boston, on "Electric Lighting Stations as Fire Risks," as also on account of a report made at that meeting on the workings of the New England Electric Exchange.

Your committee, in order to make an intelligent report, has, after deliberation, sent out two circulars, one addressed to the Board of Underwriters and other insurance associations. The one addressed to the insurance bodies was as follows:

HEADQUARTERS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

18 Cortlandt St., Room 512, New York, May 1, 1889.

Committee on Harmonizing Electric and Insurance Interests, to Fire Insurance Underwriters' Associations:

Gentlemen: The undersigned, members of the National Electric Light Association, were, at the Annual Convention of that Association, held in Chicago, in February last, appointed a committee to report to the semi-annual convention of the Association, to be held at Niagara Falls, in August next, some plan for securing throughout the whole United States the same mutual co-operation and harmony between fire insurance and electric lighting interests, that is now enjoyed by those two interests in New England.

Believing that all fire underwriters, through their several organizations in the different sections of our country, will only too willingly lend their aid and co-operation to any plan having in view the lessening of the fire hazard

incident to electric lighting, by securing better and safer work in installing and operating such apparatus, we are induced to address this circular letter to you, asking for an expression of views from your organization upon the feasibility and desirability of introducing within the territory of your body methods similar to those in operation in New England and which are giving such happy results.

It is a well-nigh universally acknowledged fact that the fires resulting from electric lighting are very largely due to construction work performed by men who possess a too limited knowledge of the theory and science of electricity to enable them to do safe work, or we might better say, to prevent them from often doing *unsafe* work, both in the matter of construction and operation.

Being led by experience to a firm conviction of the fact just stated, a number of gentlemen engaged in electric lighting in New England, over a year ago, came together and formed an association called the "New England Electric Exchange." The main object of this Exchange, which is composed of persons owning and superintending any electric light plant or company, is to have every person employed by them, in any responsible capacity, examined by a competent committee of electrical experts as to his qualifications for the position he holds, and, if found competent, a license certificate to be issued to him. Certificates are classed into several grades, so that the person examined for a certain grade, if found lacking in the qualifications necessary to secure him a license for that grade, may, however, receive a license of a lower grade. He is thereby stimulated at once to so improve himself in electrical knowledge as to be able to receive, upon a re-examination, the license which he first sought, or even of a higher grade.

By this system of examinations the licensee is obliged to prove his fitness to be entrusted with the handling of apparatus which, though possessing many elements of danger, may be so installed and operated that this danger, or fire hazard, is reduced to a minimum.

It is believed that if the co-operation of the fire insurance organizations was promised, in such ways as they might honorably and consistently co-operate. The National Electric Light Association would recommend the formation of Electric Exchanges for similar purposes throughout the country generally.

Of course, there are many engaged in electric lighting who would not willingly submit themselves to examination for license unless it seemed for their personal interest so to do.

The co-operation of insurance companies could be had by their requiring in their permit for the use of electric lights, a guarantee that the apparatus had been installed and was being operated by a person holding a license from some electric exchange.

Further aid and encouragement could be given by making reasonable concessions in rate of premium on property where the use of electric lights was guaranteed, to the exclusion of the more unsafe methods of illumination.

The almost entire immunity from electric light fires in New England (the direct result of careful, honest and intelligent work) has already induced the New England Insurance Exchange to make quite general reductions in tariff rates for such guarantees.

In closing, we would earnestly ask your careful consideration of the subject, concerning which we believe you can entertain only a favorable view, and we would be pleased to receive your ideas in full at your early convenience, to the end that we may make a comprehensive report to the August Convention. Very truly yours,

P. H. ALEXANDER, Chairman,
General Manager Sawyer-Man Electric Light Co., Boston, Mass.

H. B. CRAM,
Treasurer Bernstein Electric Co., Boston, Mass.

M. J. PERRY,
General Manager Narragansett Electric Light Co., Providence, R.I.

M. J. FRANCISCO,
General Insurance Agent and President of Electric Light Co., Rutland, Vt.

S. E. BARTON,
Special Agent Royal Insurance Co., and Chairman Electric Light Committee, New England Insurance Exchange, Boston, Mass.

Committee.

The other was addressed to all the Electric Light Companies "operating stations" throughout the United States, and read as follows:

HEADQUARTERS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION,

18 Cortlandt Street, Room 512, New York, May 1, 1889.

Committee on Harmonizing Electric and Insurance Interests, to the Officers and Managers of Electric Light Companies:

A prejudice has been created among insurance companies against electric light plants as insurance risks, in consequence of which rates have steadily advanced until the tax has become oppressive. In addition to this, a large number of companies have placed them upon the prohibited list.

The undersigned were appointed a committee by the National Electric Light Association at the annual meeting in Chicago, February last, to devise ways and means to effect, if possible, a change in the position and views of the insurance companies.

We sincerely believe if the fact was known that the premiums paid on electric light property are sufficient to pay all losses and expenses and still leave a good surplus, that all first-class insurance companies could be induced to write them freely at lower rates.

We have undertaken to secure statistics sustaining such belief. We trust that all electric light companies will cheerfully lend their aid and assistance to any plan which will lessen the cost of insurance, as the results would be beneficial to all concerned.

We enclose a blank form to be filled and returned to the headquarters of The National Electric Light Association, and request that every interrogatory

be answered carefully and fully, so that we may be able to make comparative tables that will prove valuable additions to the records of the Association.

In our report, names of stations or companies will not appear, simply the aggregate amounts.

P. H. ALEXANDER, Chairman,
Genl. Manager Sawyer-Man Electric Co., New York.
H. B. CRAM,
Treasurer Bernstein Electric Co., Boston.
M. J. PERRY,
Genl. Manager Narragansett Electric Light Co., Providence, R. I.
M. J. FRANCISCO,
President Rutland Electric Light Co., Rutland, Vt.
S. E. BARTON,
Chairman Electric Light Committee, New England Insurance Exchange, Boston, Mass.

Committee.

Accompanying the latter was a blank, spoken of in the circulars, and asking for the following information. We give here the form of the blank:

FILL OUT AND RETURN THIS BLANK TO THE HEADQUARTERS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, 18 CORTLANDT ST., NEW YORK CITY.

Premiums paid for two full years previous to April 1st, 1889.

Give amount paid each year separately, - -	First year,	$
	Second year,	$
Amount insured, - - - - - - - - -	First year,	$
	Second year,	$
Losses collected, - - - - - - - - -	First year,	$
	Second year,	$

Cause of fire ....

Is any other business or trade carried on in electric light station, if so what? ....

Is building brick or wood ....

Was station built expressly for electric business ....

Name and address of Electric Light Co.

....

....

We regret to say that the responses from the insurance bodies were but few, not owing to any unwillingness on their part to co-operate with us in reducing the rates on central stations or in establishing rules for the installation of electric light plants, that would rate buildings in which electric lighting was employed as better risks than those using other artificial illuminants, but rather to the lack of organization, which does not permit the insurance companies acting as a tariff association to make rules or rate insurance that will be abided at by the different companies composing the organization. We have, however, received some very encouraging replies, some of which I hereby annex.

HOME INSURANCE COMPANY.

NEW YORK, May 27th, 1889.

National Electric Light Association, 18 Cortlandt St., New York City.

Gentlemen: Referring to the circular of the Harmonizing Committee of your Association, addressed to the writer, as President of the New York Tariff Association, would say, that while the plan proposed by your Association for the improvement in the installation and operation of electric light plants, meets my personal approval. The fact that the New York Tariff Association no longer exists will render impossible any efforts for co-operation.

Yours truly,

(Signed) J. H. WASHBURN.

THE LIVERPOOL AND LONDON AND GLOBE INSURANCE COMPANY.

CINCINNATI, O., July 27th.

(Stenographic.)

ALLAN V. GARRATT, Secretary, 18 Cortlandt St., Room 512, New York City.

Dear Sir: Your circular of May 1st has our attention. We would personally favor an association for mutual co-operation between fire insurance and electric lighting interests, similar to that enjoyed in New England. Our own local association has in its employ an expert electrician. Our city fathers also have in their employ a similar professional.

Our Local Association would hardly feel like taking the initiative in establishing an Exchange including the whole of Ohio, or Ohio and Indiana. The general interests of these States are managed by the Western Union, and organization of Insurance Managers, Mr. J. H. Washburn, of New York City, President.

Very truly,

(Signed) J. M. DE CAMP, G. A.

F. J. HOAG,

TOLEDO, O., July 30th, 1889.

ALLAN V. GARRATT, Sec'y, N. Y. City.

Dear Sir:—Your circular urging co-operation between fire insurance and electric lighting was duly received and read at a meeting of our local board.

We have lately given this matter considerable attention here and our electric companies are now operating under directions of a city electrician, who thus far secures satisfactory work. No action was taken, but your plan seemed to meet with general approval, and our association would probably endorse any system you may devise at the coming Convention.

Very respectfully,

(Signed) F. J. Hoag,

Toledo Board of Underwriters.

PHOENIX INSURANCE COMPANY, OF HARTFORD.

Atlanta, Ga., July 13th, 1889.

National Electric Light Association,
18 Cortlandt Street, New York.

Gentlemen: Your circular of May 1st, to the South Eastern Tariff Association, has been duly handed me as Chairman of the Electric Light Committee of this Association. I would be glad to ask how we might form an alliance, and how would the connection be of mutual advantage. We are willing to co-operate with any and all associations that might lessen the fire hazard. In this section of the country, as you must know, the electric light is somewhat new and we have had more or less losses (in the main, however, I believe the losses have been small). This association is now contemplating the practicability of employing an electrician, and we would like to ask if you could furnish such person and at what price. We are also at this time in correspondence with the "New England Insurance Exchange" on the subject of electric lights and electricians. We would be pleased to hear from you on this subject at your earliest convenience. Yours truly,

(Signed) J. S. Raine.

THE CLEVELAND BOARD OF UNDERWRITERS.

Cleveland, O., July 8th, 1889.

P. H. Alexander, Esq., Chairman Committee National Electric Light Association, 18 Cortlandt Street, New York.

Dear Sir: Your circular letter of May 1st to "Fire Insurance Underwriters' Associations" was duly received, and after being read at a regular meeting of the Board, was referred to the Executive Committee for proper action. The Committee instruct me to reply that this Board will heartily endorse any proper method by which better work in putting in electric wires and apparatus may be secured, being occasionally sharply reminded that the competition for contracts for installing electric plants has become so intense as to result in the employment of unskilled labor and the use of improper materials, whereby much loss to property owners and insurers has happened. We have heard and read something of the plan adopted in New England and all we know of its operation is favorable, and our Board would be inclined to co-operate towards the introduction of some similar means for bettering the fire hazard hereabout.

We venture to suggest in this connection that to obtain the best results, it would be well to secure the widest co-operation from the manufacturers of electric apparatus.

The power to give or withhold a permit to put up electric work is one involving grave responsibility, and the selection of an examining committee should be managed with such discretion that all who are willing to unite their efforts for the purpose aimed at, should have a fair opportunity for representation. There ought to be no difficulty with a proper organization to secure the united assistance of electricians and insurers. No doubt all the points of the subject have been duly considered by your Association or will be at your August meeting.

We shall be happy to be favored with the results of your deliberations.

I am, with much respect, Yours sincerely,

(Signed) R. F. CHAPMAN, Sec'y.
Cleveland B. of U.

CRESCENT INSURANCE COMPANY.

NEW ORLEANS, LA., June 17, 1889.

P. H. ALEXANDER, ESQ., Chairman,
Boston, Mass.

Dear Sir: The Electrical Committee of the New Orleans Fire Underwriters' Association for the present year is composed of Clarence F. Low (Agt. Res. Sec'y L., L. & G. Ins. Co.), James Picton (Agent for several companies) and myself as chairman.

To this committee was referred your circular letter of May 1st. We can only say that we should be delighted to have organized in this section an Electric Exchange similar to the New England, and there would be little, if any, difficulty in getting our organization to insert in the permit that "Apparatus had been installed and was being operated by a person holding," etc., as a guarantee.

As to further encouragement in the way of "Reasonable Concessions of Rate," etc., we cannot now indicate what our body would do. Generally speaking, insurance companies are willing to make concessions for value received.

You will find underwriters here willing to co-operate with you along the line of greater safety in the electric business.

Very truly,
(Signed) W. R. LYMAN, Chairman.

PHILADELPHIA FIRE UNDERWRITERS' ASSOCIATION.

PHILADELPHIA, May 27th, 1889.

P. H. ALEXANDER, ESQ., Chairman, etc.,
18 Cortlandt St., New York.

Dear Sir: Your circular letter of the 1st inst., has but just reached me. Our uniform practice has been :

1. No permit to be given for use of electric light until the installation has been approved by our inspector.

2. Specific amount to be covered on electric light plant (separate from other items insured by the policy).

3. Burning out of armature or similar damage to dynamos (not covered by the policy).

Most of our inspectors are made by Inspector McDavitt from our Fire Insurance Patrol, he devotes all his time to this branch of our work, and has done so with marked success for many years.

Our association will always be glad to aid in securing "mutual co-operation and harmony between fire insurance and electric light interests," having in view the lessening of the fire hazard incident to electric lighting, by securing better and safe work in "installing and operating such apparatus" and if you will send me what printed matter you have, that relates to the method of the New England Insurance Exchange, I will lay them before our association for such action as it may see proper to take. It is not probable, however, that any concession will be made in rate for that system of lighting. Awaiting your further advices, I am,

Yours very truly,

(Signed) GEO. E. WAGNER, President,
417 Walnut Street.

UNDERWRITERS' ASSOCIATION.

PHILADELPHIA, July 31st, 1889.

ALLAN V. GARRATT, Esq., Secretary National Electric Light Association, 18 Cortlandt Street, New York.

Dear Sir: At a stated meeting of this Association, held on the 6th inst., Mr. James T. Ryan was appointed to represent this Association at the meeting to be held at Niagara Falls, on August 6th, 7th and 8th.

Yours truly,

(Signed) E. R. CLEMENCE, Secretary.

BOSTON BOARD OF FIRE UNDERWRITERS.

BOSTON, July 26th, 1889.

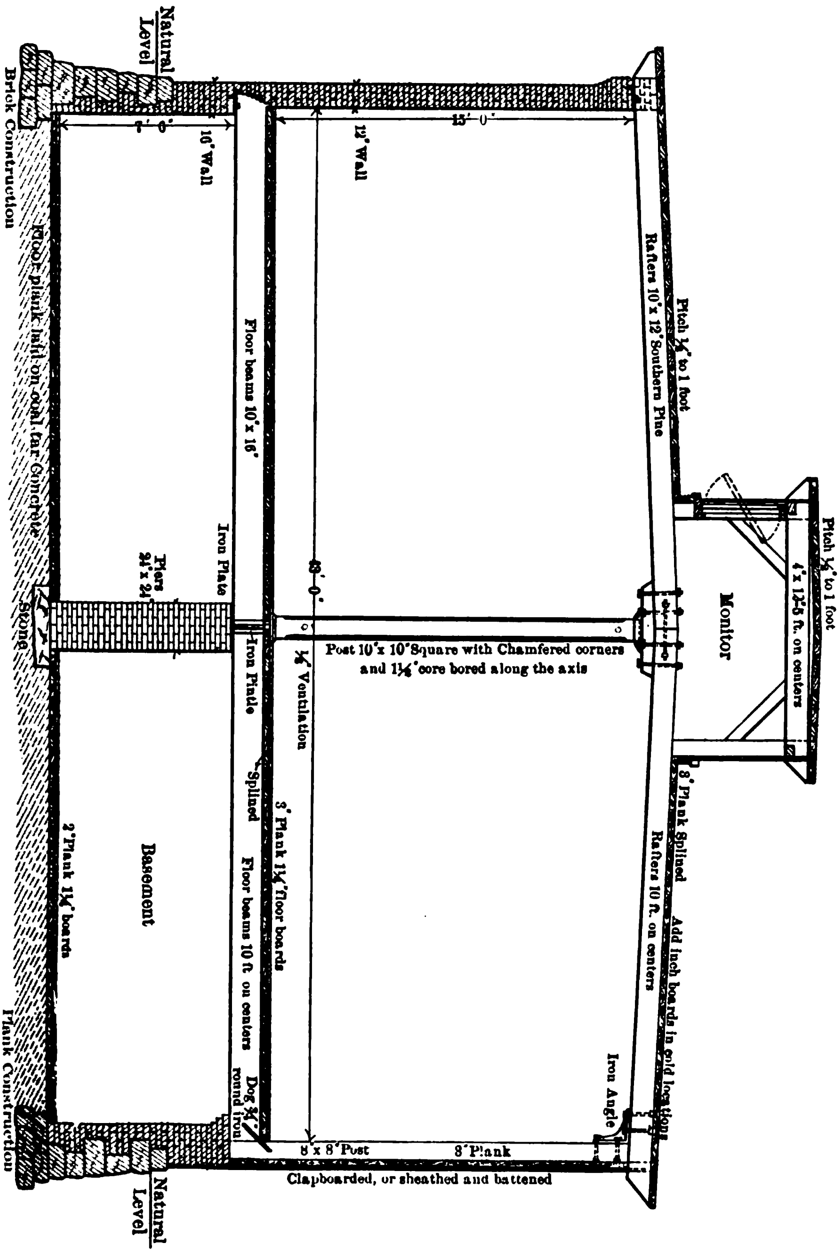
ALLAN V. GARRATT, Esq., 18 Cortlandt Street, New York City.

Dear Sir: In reply to the circular of the National Electric Light Association, permit me to say, that the Boston Board of Fire Underwriters has already adopted rules making it necessary for those having anything to do with electric lighting or electric power to obtain a license for the Electrical Exchange. In the case of isolated plants where this license is not obtained, the rate is increased ten cents. It seems to me it will hardly be necessary for us to take any further action in this matter.

I am, yours truly,

(Signed) OSBORNE HOWES, Jr., Secretary.

(Stenographic.) per L.L.D.


Natural Level
Brick Construction
7'-0"
16" Wall
15'-0"
12" Wall
Rafters 10"x 12" Southern Pine
Pitch 1/8" to 1 foot
Floor beams 10"x 16"
Floor plank laid on coal tar Concrete
Iron Plate
Piers 24"x 24"
Stone
43'-0"
Post 10"x 10" Square with Chamfered corners
and 1¼" core bored along the axis
Monitor
Pitch 1/8" to 1 foot
4"x 12"-5 ft. on centers
Iron Pintle
1/8" Ventilation
8" Plank Splined
Rafters 10 ft. on centers
Add inch boards in cold locations
Splined
3" Plank 1¼" floor boards
Floor beams 10 ft on centers
Basement
2" Plank 1¼" boards
Plank Construction
Dog ¾" round iron
Iron Angle
8"x 8" Post
8" Plank
Clapboarded, or sheathed and battened
Natural Level

CANADIAN FIRE UNDERWRITERS' ASSOCIATION.

(TORONTO BRANCH.)

OFFICE, COR. YONGE AND WELLINGTON STS.,
TORONTO, August 3d, 1889.

ALLAN V. GARRATT, ESQ., Secretary and Treasurer, National Electric Light Association, New York.

Dear Sir: Replying to your circular, 1st May, marked "second communication," first of which I did not receive, this association will most willingly assist and co-operate with any electric light association with a view of harmonizing the two interests and diminishing the fire hazard. We will gladly do anything to elevate the standard of employés engaged in electric light installation and material used. At present, in Canada, a rigid inspection is insisted on by the insurance companies and permits issued before lights can be used. Enclosed herewith certificate form, also by same mail I send copy of rules and regulations of the association. Yours very truly,

ROBERT MCLEAN, Secretary.

FIRE UNDERWRITERS' ASSOCIATION OF THE NORTHWEST.

MILWAUKEE, August 3d, 1889.

ALLAN V. GARRATT, ESQ., Secretary, 18 Cortlandt St., New York.

Dear Sir: I am in receipt of your second circular communication of May 1st last, with reference to the formation of electric exchanges in the Western country, in accordance with the views expressed in your circular letter.

Our association meets some time in the early part of next month. The correct date you will see published in the insurance journals within the next few weeks, when it may be well for one of your officers to appear before the association, and give a personal explanation of the workings of such an organization as you desire to establish, and the benefits which would accrue to the underwriters.

The insurance companies are always ready to encourage anything looking to the reduction of the loss ratio, and, if the plan you propose seems feasible, they, no doubt, will take favorable action on it. Yours truly,

J. C. GRIFFITH, Secretary.

THE NORTH BRITISH AND MERCANTILE INSURANCE COMPANY, OF LONDON AND EDINBURGH.

UNITED STATES BRANCH, 54 WILLIAM ST., NEW YORK.

August 3d, 1889.

P. H. ALEXANDER, ESQ., Chairman, New York City.

Dear Sir: The efforts of your Association to reduce the hazard of electric light wires to the minimum will meet with hearty co-operation of the Iowa Union of Underwriters.

Our organization is such that but few of our laws or rules are absolutely mandatory, so that I doubt if we can be of much benefit to your Association further than to lend it our influence and to request compliance with your

rules. All of which would possibly be gladly granted if properly presented to our members. Personally, I shall probably be glad to assist you in any way I can.

Yours very truly,

H. N. Wood,

President Iowa Union of Underwriters.

Some of the associations appointed delegates to attend the Convention.

You will readily see that with proper work on your part, such as the examining and licensing of men employed to make the electrical installations, encouraging thorough inspection of work done, etc., harmonious action can be brought about.

The 876 circulars issued to electric light companies, circulars that were issued entirely in their interest, the publication of the result of the answers to which could only have the effect of putting money into their pockets, were, we are sorry to say, answered by but 241 companies; of these 241 companies, 172 were insured, 69 were not insured. In many cases they state (where it is not stated, the reasons are probably the same) that they carry no insurance, because the rate of insurance was either too exorbitant or they could not get any insurance at all, and, here we may probably say, in extenuation of the lack of responses from several hundred companies, that they were probably not insured, or not seeing through the purport of our circular, did not think it worth while to reply.

The amount of insurance carried by the 172 insured companies reported was, in the year ending April 12, 1888, $2,970,540. The premiums paid thereon amounting to $41,319.81. The losses collected during that year were $21,597.61, showing that year a gross gain to the insurance companies of $19,722, or 48 per cent. on the amount of money received. In the year following, the amount of insurance on central stations as far as reported amounted to $3,199,473. The premiums received on such amounted to $51,565.57. The loss during that year, however, amounted to only $11,000, leaving a good balance to the insurance companies.

The decrease in the amount of losses shows also that great intelligence had been displayed in providing central stations and diminution of fire risks. The total for the two years then has been insurance, $6,170,013; premiums collected, $92,885.38 ; losses paid, $32,697.61.

You will see that the losses amount to but 35.2 per cent. on the premiums paid. A very small amount indeed. An amount that ought to reduce the premium on central stations fully one-half on their present rate. The average amount of insurance on each station amounted to $18,841.50.

The following interesting data were also obtained from the answers received by your Committee, out of the number of central stations responding to the circulars. We find that two-thirds, or actually 66 per cent., were built of brick, 22 per cent. of wood, seven per cent. of stone, and five per cent. of material unknown. Only 69 stations of the 234 were built expressly for electric lighting purposes and exclusively used for that purpose.

We also looked into the causes of the fires that have occurred, and find that 31.4 per cent. of the losses occurred by tramps setting fire to stables in proximity to stations, 28 per cent. spontaneous combustion, eight per cent. crude oil for fuel, one per cent. wooden roofs over boiler, 0.2 per cent. lightning, 0.2 per cent. oil waste under engine room floor, 0.2 per cent. sulphuric acid, and 31 per cent. causes unknown.

With a desire to diminish fire risks in central stations, the New England Insurance Exchange has issued a form of what they call a model electric light station, and are insuring such a station at a very low rate. They also note on their circular, however, the gradual increase of the insurance rate by any one or more deviations from the rules laid down for a model station as printed in their circular.

A model station should comply with the following:

CONSTRUCTION, ETC.

A standard risk must be built of brick or stone not over two stories high (except a wire tower may be approved); slate, metal, gravel or other non-combustible roof; brick, metal, or plain open cornice, plain "mill construction." Stairs and elevators outside, or if inside, the former cased up and provided with self-closing doors and the latter with self-closing hatches. Boilers and chimney outside, or if adjoining building, to be thoroughly cut off by approved fire walls projecting through the roof and fire doors; occupied for no other purpose except the legitimate uses of the station itself. Unexposed by contiguous hazards, or if exposed, to have approved fire walls on exposed sides.

FIRE PROTECTION.

Must have city fire department with fire alarm box near by; or if waterworks only, a hydrant on not less than a four-inch pipe (with water pressure of not less than 60 pounds) must be located within 150 feet, and ample hose and nozzles owned and kept ready for use by owners of stations, unless public hose house is near by. If neither city fire department nor waterworks, must have a fire pump of approved kind and capacity, with ample hose and nozzles. Must have at least one-half dozen fire pails kept full, on each floor, or to each 2,500 feet of floor space or fraction thereof, with ample water ready for immediate use; also small hose supplied from tank or waterworks, the hose to be constantly attached to supply pipe inside of each room and having nozzles without cocks.

ELECTRICAL ARRANGEMENTS.

Dynamos must be insulated on thoroughly dry wood, "filled" to prevent absorption of moisture. A waterproof cover should be provided and kept over each dynamo when not running.

Wires from dynamos to switch board, and thence to outside lines, must be covered with a suitable heavy insulation, and all wires of opposite polarity not less than one foot apart.

Conductors from ceiling or floor to switch board may be run at a less dis-

tance than 12 inches from each other, and in that case an approved insulation must be provided.

All conductors must be run in plain sight, and on glass, porcelain or hard rubber hook insulators. Cleated work will not be accepted.

If conductors from dynamos are run under floors (except the space underneath be a perfectly dry finished room, and not less than six feet between floors), they must be specially insulated, and will then be subject to approval.

All wire connections should be soldered, if necessary, to secure good contact.

High potential switch boards must be so located that they will be accessible and open on all sides, and entirely disconnected from all woodwork or combustible material; also kept free from moisture. They should be as near non-combustible as possible.

Low potential switch boards must be constructed the same as those for high potential, so far as accessibility, protection from moisture, firm connections, etc., are concerned. Switches must have ample capacity and contact to carry their maximum load without heating. Bus wires or bars carrying the current of two or more dynamos, and all connections thereto, must have sufficient sectional area to prevent heating, and must be well insulated on non-combustible supports.

Feeder equalizer frames must be constructed of non-combustible material. They must be open and accessible on all sides and supported at least one foot from wooden floors, partitions or other woodwork. Nothing should be placed around them to obstruct a free circulation of air through them, and they must be so placed as to be in plain view of the station attendants at all times.

All currents having an electromotive force of over 500 volts will be treated as high potential, or arc light currents.

Wires leaving the station must be in accordance with the rules of this "Exchange," and provided with approved lightning arresters.

CARE AND ATTENDANCE.

A competent man must be kept constantly in the dynamo room while the dynamos are running. Oil must not be allowed to accumulate on the floor, and all oily waste must be kept in regular metal waste-cans, or removed from the station daily after the dynamos are stopped and cleaned. Arc lamps must always be provided with perfect globes. "Exchange" rules as to safety fuses and all like devices must be observed. Rooms occupied for storage of supplies, or for repairs, must be kept in a clean and orderly manner.

The rate of insurance for such standard station is.........	$0 75
Charges for deficiencies as follows:	
1. Frame...	10
2. Over two stories high; for third story (a basement will not be regarded as a story)..............................	5
3. For each story above third..........................	10

4.	Shingle roof	$5
5.	Cornice (except as provided in "Standard") on exposed station	5
6.	Sheathing, lath and plaster, or any finish leaving concealed spaces, according to discretion, but not less than	15
7.	Stairs or elevators inside (except as provided in "Standard")	10
8.	Boilers and chimney (except as provided in "Standard"), at discretion, but not less than	15
9.	Without any of the fire protection as required in "Standard" at discretion, but not less than	50
	(If only partial "Standard" requirements as to fire protection, at discretion.)	
10.	If fire pails and water only, not less than	40

ELECTRICAL ARRANGEMENTS.

11.	Dynamos, unless as required by "Standard"	25
12.	Insulation, unless as required by "Standard," at discretion but not less than	25
13.	Conductors, if concealed, at discretion, but not less than	25
14.	Conductors, if run under floors, except as permitted by "Standard"	25
15.	Switch boards, unless as required by "Standard," at discretion, but not less than	50
16.	Feeder equalizers' boxes, unless as required by "Standard," at discretion, but not less than	50
17.	Care and attendance, unless as required by "Standard"	25
18.	Exposure, at discretion, but not less than	10
19.	Other occupancy of station, at discretion, but not less than	10

Insurance on dynamos must be specific, and rate to be 25 cents in excess of schedule.

In view of all the investigations and information gathered, the Committee would recommend that The National Electric Light Association form within its body an organization having for its purpose the improvement of the electric service in general, the better education of the workmen engaged in the business of installing electric light and power plants, and the improvement of electric work generally.

The Committee would especially recommend that examining boards be formed in the different districts, composed of several States, where men seeking employment as dynamo tenders, wiring superintendents, or others holding responsible positions in conjunction with electric light installation can be examined, and to whom can be issued by the organization a certificate of efficiency, stating the qualifications, and for what particular work, the man possesses.

The Committee would also recommend that members of this Association pledge themselves to have all men in their present employ examined in the manner proposed and not to employ any person hereafter not provided with such certificates. In doing this the confidence of the insurance people will be speedily restored, and they will see that the electric light interest is beginning to have pride in its own work and is trying to live down the bad reputation certainly earned by some individuals in former electric installations.

Respectfully submitted,

P. H. ALEXANDER, Chairman.
H. B. CRAM,
M. J. PERRY,
M. J. FRANCISCO,
S. E. BARTON,
Members of Committee.

THE PRESIDENT: The exhaustive paper of Mr. Alexander is now before you for discussion.

MR. ALEXANDER: As I have already stated, there are quite a number of insurance men here that are sent as delegates by different organizations, I believe, and who have come from afar, and I hope the Association will have the pleasure of hearing from some of them.

MR. MORRISON: I move that the privilege of the floor be accorded to the representatives of the insurance companies for the purpose of taking part in the discussion.

Mr. Lynch seconded the motion.

The President put the motion and declared it carried.

THE PRESIDENT: The Chair recognizes in the Convention Mr. Barton, of Boston, an old friend, whom we would like to hear from.

MR. S. E. BARTON (of Boston, Mass.): Mr. President and gentlemen. I hardly feel myself a representative of the insurance interest solely. I am a member of The National Electric Light Association, in which Association I take great pride. There are some gentlemen here who are appointed as special delegates; one or two representatives, I believe, from the New York City Association, and one representative from what is known as the Middle Department Association, covering the States of Pennsylvania, Delaware and New Jersey. There were several others, I believe, who were promised, but for some reason have failed to connect. They do not seem to be here.

I think it is pretty well understood what the position of the underwriters is as regards the matter of electric lighting, and I hardly feel that it is necessary for me to take up the time of the Convention with any extended remarks. I think different Conventions have been sufficiently bored with my chin music in the past. I am always very glad to speak upon a subject that relates to a new interest; but I feel now that I should yield the time to my brother representatives who are here and who can speak for those organizations which are more particularly interested in the work of this Committee, and who have been invited here. We have with us Mr. Anderson, of the New York Association, and Mr. Barton, both members of the Electric Lighting Committee of the New York Association, and Mr. Ryan, who is a representative of the Middle Department. I think the Convention would be very much pleased. I should like very much to call upon Mr. Anderson, and when he finishes, upon Mr. Barton and Mr. Ryan. I know that they are all thoroughly in sympathy with us.

Mr. Barton: I will not consume the time of the Convention in entering again upon the branch of the subject that has already been covered. The situation of the boards in New York is very peculiar and different from that of any other organization; and while we may not be able to pledge ourselves as far as some other boards may feel themselves authorized to commit themselves, it is only fair to say that we have worked for several years in the interest of good practice in the solution of electric plants, and we want to co-operate with the electric light companies, and will cheerfully co-operate with the electric light companies in furthering the good work and will go as far in the matter of safety as the companies themselves are willing to go. They cannot be too safe for us, and we will gladly enforce, as far as the rules of our board will permit us, the most stringent regulations that can be laid down. I say this in our behalf, but our jurisdiction is over very limited territory, the cities of New York, Brooklyn and Jersey City. We should be very glad to meet a committee from this organization and see if we could not agree. I believe we could agree upon details for the proper conduct of the business of electrical companies and ourselves that should be satisfactory to both in the City of New York. (Applause.)

Mr. William Anderson: We find in the City of New York that our architects are entirely ignorant of what should be done in the construction of electric light plant in a building. Without consulting the underwriters, they have made their specifications, and made their contracts for electric lights in accordance with our rules.

Now, we think that this Convention could do a good work to invite a Committee of Underwriters from the City of New York and other large cities and have them educated so as to draw out the proper plans for the insulation of wires in the different buildings. We know it is the desire of all electric companies to do good work at a good price, but if they can't do good work at a good price, they will do it at a small price; and by acting in concert to prevent this cheap work, we will all be benefited, and I think that it is the proper thing to get them to work in harmony with you. I know they are very desirous of doing it. Some very expensive buildings are now in contemplation, and one point that I hope this Convention will consider is to get the architects to work in harmony in their erection.

Mr. James T. Ryan: As a representative of the Middle Department. I have been sent here to hear what you gentlemen have to say in regard to this matter.

I heartily reiterate the sentiments expressed by the gentlemen here in saying that the association over which our department has control will put forth its best endeavors to meet you halfway and try and do everything in our power to make the interest of the electric light stations as our own. I have been delegated by our Association, and in that capacity I have examined a great many stations in Pennsylvania, and I have seen a number of electric light men, and the best of them complain bitterly of the competition of irresponsible people. It seems to me it lies within your power to help us out in this respect, to make such rules as you think it is proper and we will enforce them to the best of our ability. I think that by both associations working in harmony, a great deal more good can be done than is thought of at this time.

Mr. S. E. Barton: Mr. President, before this subject is passed, I would like to state that I am not only a member of the New York Fire Underwriters, and a delegate from that associa-

tion, but I am also a member of the New York State Association, which association has jurisdiction over this State outside of New York City. This circular was formulated at the July meeting; a committee was appointed to represent the organization at this meeting to-day. The delegate is not here. I can only say that the expression of feeling in the convention was a very hearty one to co-operate with this Convention here, and I presume the only reason why the gentleman is not here is because, like all of us, we are in the employ of individual companies, and he has, perhaps, been called away by his company and could not leave that work to attend here. If I may be permitted to say a word about one subject presented in this report on the subject of insurance—it is the question of statistics given in regard to fire loss and fire premiums on stations. The amount at risk and the amount of premium is so small, compared with the amount of value involved in this great work, that the statistics presented may or may not be misleading. I could not, and no man who makes underwriting statistics his study at all, could pass any opinion as to the merits of the statistics that have been presented. I am very glad that the committee have commenced this work, and I hope by another year they will get it into different shape. In this connection I wish to say that one feature that is omitted is a very important factor to the underwriter, and that is the value of the plant. You ask for the amount of insurance and the amount of premium paid; having them, you will get one other factor, the value of the plant. If a plant is valued at $125,000, and is burned, it makes a total loss to the owner. If he takes $10,000 of insurance he only gets ten per cent. You take simply a $10,000 loss on a $125,000 fire, and your statistics are not worth anything, because the next man that has a $25,000 loss, perhaps, had insured a $25,000 value, and he had full insurance. In one case we pay ten per cent. loss on value, and in the other a total loss on value—a very different thing.

MR. ALEXANDER: Mr. President, I am very glad Mr. Barton has brought this matter up. The premium received is in exact proportion to the amount insured. Where the loss is $10,000 on a $100,000 station, if the insured has paid premiums on $10,000, then the insurance company gets its full value.

THE PRESIDENT: Is Mr. W. J. Morrison, of Fort Wayne, in

the room? I have here telegrams for Mr. Eustis and W. H. Lawrence.

After this interruption, Mr. Alexander continued:

In making up the statistics, the gentleman probably notices that several companies have not replied. A good many of them are, doubtless, insured and paying premiums.

While we have looked after the losses as far as possible, we have only one loss not recorded. The manager of that station told me that the amount collected was $38,000—a station in Boston. There is no doubt that, to offset that, we have not received the amount of premium paid by numerous companies insured and not reported. Therefore, the statistics made up show merely the amount of premium received from the companies reporting, the amount of losses collected by the companies reporting, and the amount insured. Therefore, if we would take those 240 odd companies out of the 834 companies, and take the other companies and say, here is an average for 240 companies insured, of, say, $18,000 for each station, we surmise that the other companies not reporting would also have an average of $18,000 insurance. There is this immense amount of money that the insurance companies could gather in in premiums, and the losses proportionately would not be larger. You can see that, because the insurance companies do insure a good station at 75 cents. Now, it is for you to make such rules as to bring the stations up to conform with your requirements, and then your losses will doubtless be small and you can afford to insure at that rate.

Now, in regard to a suggestion made by Mr. Anderson, about the architects, some time ago. I was going to propose that all electrical companies installing plants make beforehand plans—and I have done it for a long time, when I was in the business of installing plants—plans showing every floor, the wiring, etc. I showed the wires in colored pencils, No. 2 was blue, No. 4 red, and so on, and then submit that plan to the insurance inspector for approval before the wiring is done. This inspection business is an easy matter. The inspector only wants to see that the proper joints are made, fuse boxes properly arranged, and so on. Every company insuring an electric light station should have submitted to it a plan of the wiring, made out in due form.

I think that would simplify the matter and might assist the parties installing a great deal.

Mr President, I see Mr. Miller here, who is Secretary of the National Insurance Board of Underwriters, comprising all the Insurance Companies of the United States.

THE PRESIDENT: We should be very much pleased to hear from Mr. Miller.

MR. HENRY K. MILLER: Mr. President, I do not know that I have anything to add to what has already been said; but, in behalf of our association, I take great pleasure in expressing the interest we feel in this work. I shall take back to our Executive Committee a report of the proceedings of this meeting, and I think we shall have their co-operation in all matters relating to our common interests.

MR. RYAN: Mr. President, I would like to add a few words to what I have already said. I have here a few figures copied from the "Fire Chronicle," published in New York, giving the statistics of loss for three years. In 1886, there were 29 risks burned. The property lost was $460,259. In 1887, there were 66 risks burned, giving a loss of $681,930. In 1888, there were 91 risks burned, giving a property loss of $1,587,213, showing an increasing loss every year, it may be in proportion to the number of wires already strung or it may be bad work, bad plumbing or some other cause. They are in the record of fires of electric light stations. In five years, ending in 1888, there were 75 electric light station fires. The aggregate property lost was $937,608. The aggregate insurance loss, $696,422. The insurance loss to the aggregate property loss was about 66 per cent. Those figures are a little different from those given by Mr. Alexander, and it seems to me that if those companies that have not replied to him—it is, perhaps, because they are modest gentlemen and do not want to tell what they suffered because of fires. The number from unknown causes was 20 per cent., exposures, 28, aside from exposures, 25.

MR. ALEXANDER: I want to say that Mr. Ryan takes the figures of losses incurred by the burning of electric light stations. If a whole row of houses should burn up, including an electric light station, the loss of the whole fire would be charged against the electric light station by the companies.

We only ask how much the central stations have collected for their losses. I think that is the way you make it up. Is it not, Mr. Ryan?

MR. RYAN: Yes, I think so.

MR. ALEXANDER: Here is a central station located on a block where the whole block burning down caused a loss of $100,000 of property. That would be laid at the door of the central station.

MR. RYAN: In writing the hazard, we generally charge for exposures. If there is a loss, we charge the loss to the exposure.

MR. DE CAMP: Do I understand that Mr. Alexander is right in the statement that this loss would be charged to the one exposure? Does he mean that it is charged to that particular risk in making up the statistics?

MR. RYAN: I do not know positively whether these figures have been made up in that way or not. It seems to me they have been.

MR. DE CAMP: That is hardly fair.

MR. RYAN: It is published for the information of the insurance companies, and I do not think that it is unfair from their standpoint.

MR. DE CAMP: I admit that there is just the difference between the insurer and the insured that there is between buyer and seller in all cases; but another reason enters into it. If this is the case, to put it as strongly as Mr. Alexander put it, that the electric light station as a risk is charged with all that, it is certainly unfair. On one of our stations, on which we had carried $100,000 of insurance, when the policies came due, we noticed the companies going off. We have an agent who has charge of all our insurance business. I asked him whether the rates were going to be advanced, and he said no, all those people are going off—they won't have it at all. Well, for what reason? It is an electric light station. That was the only answer I could get. It is an electric light station, a station equipped as fully, I think, as it may be equipped, with extraordinary good surroundings, built exclusively for a station, and still that was the only answer to the question raised. I would like to know whether that applies all the way through? I am aware that if we had some extreme risk alongside of us, we would be charged more

on account of that risk. That I will accept. I had seven or eight years' experience in the insurance business myself, and I admit that the rate on any risk is governed by its surroundings to a very great extent. Now, if a mill is put up it is considered in a certain class of risk. If there is a dwelling house alongside of it, and the dwelling house takes fire and the mill is burned down, is that loss charged to the dwelling house?

MR. RYAN: I would like to ask did the fire occur in the dwelling house?

MR. DE CAMP: Yes; that is what I mean.

MR. RYAN: The general supposition would be that where the fire occurs that is the cause of that fire, and we attribute the fire to that cause. If it were a powder mill and burned up the whole street, the loss would be attributed to the powder mill. There was the hazard. That is the reason that we charge a greater per cent. of premium on a powder mill than we would on a dwelling house. Another thing that the gentleman makes mention of is his station being a first-class one in every particular. That may be one station out of one hundred. If the insurance companies could get every electric light station in the country and write a line on them, they might do so, but the impression has got abroad that the percentage of badly constructed electric light stations are such that the companies cannot keep a good average with the good ones.

MR. DE CAMP: That I do not take exception to. I think it is perfectly proper. I would look at it that way if I was in the insurance business, but the fact that the loss of adjoining property should be saddled on to the electric light station, I cannot understand.

MR. BARTON: I think Mr. Ryan is wrong in one particular. The company does not charge the losses on all of the surrounding property to an electrical station. Every company doing a large business keeps its own statistics, and every insurance company is just as anxious for business as the electrical companies. They have insured electrical stations until the balance is on the wrong side, and their experience has been such that you have hard work to get a sufficient amount for an electric light station to make any large value. If you build them so that they won't burn in the next five years, you will find companies going for those

risks as much as for other risks. If you make the risks so that they won't burn, you will find us coming up for them.

Mr. M. J. Francisco (of Rutland, Vt.): In regard to fires in electric light plants, if you will investigate the subject, you will find that the trouble has been generally with the risks themselves. Electric light stations have been placed in all sorts of clap-trap buildings of every description, and the fire, in nine cases out of ten, has been occasioned by some other business that has been carried on at stations besides the electric light business. After the Chicago Convention, I spent several weeks in investigating the electric light stations, and traveled over 7,000 miles for that purpose. I found a large number of stations where every species of business almost was carried on in connection with the electric light business. Now, if a fire has occurred or does occur in any one of those stations, it would be charged to the electric light stations as the cause of that fire. Now, in these statistics that this committee has obtained, they found 28 per cent. was caused by outside—

Mr. Alexander: Over 34 per cent.

Mr. Francisco: Over 34 per cent. Of course, those fires are nothing against electric light stations, and in my interviews with insurance companies—and I have had quite a number; I have been in that business myself—I find that nine-tenths of all of the insurance managers, in answer to my question why they didn't take electric risks, have answered that they did not know where the hazard was and, therefore, in order to be on the safe side, they let them alone.

Now, take this illustration of Mr. Anderson. I have talked with the representatives of companies where they have lost money on those risks, but you examine the losses which they have sustained and nine out of ten are in these very stations where they have it, and make the combined hazard. Of course, the electric light hazard has nothing to do with it. That is the great trouble with our electric light stations at the present day. Combining all of these hazards which are brought in here as a sample of electric light stations, while, if a station is properly built and properly taken care of, I claim it is just as good risk as the best mercantile risk in the United States, and if insurance men will investigate the matter, they will find that

that is the case. Take a large number of the stations and investigate. The risk is not on the electric light plant, not on electricity, but on some other hazard that has been incorporated in that station, either from gross carelessness or something of that kind. For instance, here is one case of spontaneous combustion—28 per cent. of fires in such places, the account says, is due to spontaneous combustion. Well, that is gross carelessness. Of course, that occurs from all risks. But, of course, we can wipe out that hazard if we would only remove the cause of spontaneous combustion, and that is found in every class of risks. You meet it everywhere. Take that out and take all of those things out which are outside, practically, of the electric light part of the station, and you have as good a risk as can be found anywhere. There is the point, and that is the point where the electric light people have got to come right down to. Each manager must look to his own station and remove these hazards which are outside, practically, of his business and put them in proper shape, and then we will have no difficulty in regard to that fact. Now, then, you see when you get a certain number of stations of that class of property, they say they will have nothing to do with them but to throw them all out, because they have lost on those stations. As Mr. De Camp says, he has got a good station, but it has to be classed in the same category with others because they are in the class of risks the insurance companies class as hazardous. The insurance companies class them, and if they find they do not pay, they will not take them ; they will wipe them out. They say they are prohibited risks. So that a man with a good station stands no better chance than the man with a poor station, if the class of risks in which he has insured has proved a loss ; he is, of course, placed in the same category with others. That is where the electric light managers should make a change in the way in which they are doing business. They should remove all of these objectionable features in the stations, and then the insurance companies will be prepared to accept them.

MR. BARTON : Right on that point he would give a little and say that the insurance companies charge too much for the best risks and too little for the poor risks ; and the poor risks make the record, and the record gets so bad that, from the under-

writers' standpoint, he cannot say that it is to his interest or that there is money in it by going so much below the average for the best ones and throwing up his average for the poor ones; and, as Mr. Francisco says, if you will improve your stations, the underwriters will take them.

MR. MORRIS: It seems a large part of this trouble grows out of the fact that the insurance companies have not the technical knowledge of discriminating between the good and bad risks in electric light stations; they put them all together and say they are a bad risk, and that they will not take any of them. Now, if that rule is to be followed by all of the companies, or by the strong companies, then we must look mostly in the direction which is so near down that I can't get the risk hardly in any station in the city. I am building now a new station, and see the defects of the old one, and now feel independent. I say to the insurance companies, if you don't want to insure me, all right; I will carry the risk myself.

But to go one step further. I think if we can't get the companies to make this discrimination in favor of good stations, then our plan is to form a mutual co-operative insurance company of our own, and we can make the discrimination that ought to be made; and we will take the good stations and wipe out the bad stations. And I move upon that point that this committee be continued, and that they formulate or prepare some plans looking to the formation of an insurance company by electric light companies. Do I meet with a second on that proposition?

MR. LYNCH: I would like to second that proposition. I would also like to ask some of the gentlemen who have been furnishing insurance statistics, a question. I agree with Mr. De Camp, Mr. Morrison and several other electric light men. I think it very hard that the electric companies should bear all of the insurance that is lost through any fire in the electric light works, and I would like to ask the insurance men if the loss sustained some 15 years ago by the burning of the larger portion of the business portion of Chicago by fire—which, as we all know, was caused by a cow kicking over a lamp in a one-horse stable—I would like to ask them if all the losses sustained in that fire was laid to that cow stable?

MR. ANDERSON: In regard to the statement that all insurance

companies pass all electric light stations in a body, I think the gentleman who made that statement knows better. Mr. Lynch knows that stations are occupied for other purposes; he knows that the insurance companies rate them a higher price than they do when they are used for that purpose alone. Every one cognizant of insurance matters, either in Boston, New York or the large cities, knows that the insurance companies make discriminations in the way in which stations are built. We have some stations in New York to-day that are insured, I think, as low as one per cent.—I think as low as 75 cents; we have some that it is hard work to get insured at four per cent. They did that in all classes. The result was so disastrous to companies that for awhile they let them drop out and some one else took the chance as extra hazardous insurance. I think that no company ever made an improvement in the plan. As you have heard read to-day, the Boston Board have shown you that if you build the stations according to their plans you can insure them for 75 cents. Now, what more can you have insurance companies do than that? They say we are willing to meet you as far as you are willing to go.

Mr. S. S. Leonard (of Minneapolis): For the past two years I have been fighting insurance companies to the best of my ability. Two years ago our rate was $1.50 and $1.75. We commenced to use a fuel oil and were charged one per cent. additional. All right, we said, we would pay it because we wanted to find out about the oil, and our method of handling it was very crude, and we thought that after we had found out whether it was what we wanted, that we could undoubtedly get a lower rate. We did not get the lower rate; they still charged the one per cent. additional, and yet every insurance man that has been there has said that he cannot possibly see wherein the danger lies from the use of that oil. We can get no satisfaction from the companies whatever—that is, no satisfaction from them whatever toward reducing that rate. They raised it one per cent. and we can do no better with them; and those that have seen it, as I have, said they cannot point out that there is any more danger now than there was before. As I have stated, we had more fires in Chicago resulting from the use of coal than from the oil, and yet the rate is lower. Mr. Alexander says the

loss has been greater from fuel oil. I would not be at all surprised ; it might be more than that, but that does not condemn the system by any means at all ; I should like very much to know why the insurance companies, after they investigate and see that it is no more dangerous than it was before, why they should still maintain such rates ? It seems to me that there ought to be some way to bring that matter down where we can get insurance at the proper rate.

MR. BARTON : I don't know whether I understood the motion of Mr. Alexander to be seconded or not.

A MEMBER : It was seconded.

MR. BARTON : I would like to make a motion in order to bring this discussion to a head. There are many points of the discussion that have arisen that I should like to take part in, but there are many important matters before the Convention, and I don't feel that it is right for me to consume as much time as I should like to in discussing the various points that have been brought out in the past discussion.

I would like to offer as an amendment that this Committee that Mr. Morrison called for be definite as to numbers ; I don't know as he stated the number of the Committee.

MR. ALEXANDER : The same Committee.

MR. BARTON : That I would amend by proposing that the old Committee be continued and asked to take in view the matter that Mr. Morrison has suggested ; and, also, that they be asked to invite the representatives of the different insurance organizations throughout the country to meet with them, looking to the formation of electrical exchanges throughout the country and the operation of them ; and also looking to a system of inspection for the various districts, and that they report their findings at the next meeting.

In support of that amendment, I wish to say that I don't believe any real harmonious condition of things can be brought about regarding the whole country, until a system of thorough inspection, from an insurance standpoint, is attained ; and this inspection can be done by the insurance interest, because by that interest only can an impartial inspection be had. I don't think until that is done, that the condition of things can be brought to a degree of harmony such as we have in New Eng-

land. With the very best of intentions, the very best work that may be done, and all of that, the continual changes that are going on from day to day in buildings, will upset even the very best work that can be done, it requires the constant work of an inspector in looking after these changes and defects that will creep in through changes. In New England we have two men at work at all times, and I believe that that is the secret of the absence of fires from electric lighting sources that we have there. We started in some six years ago with our inspection. We took the ground in the outset that we should not consent to assume the electric lighting hazard, without we had the knowledge that it was being thoroughly and properly done. So we appointed our inspectors and set them to work. We at once took the position that the electric lighting company must pay for that inspection; and they are doing it, and they have been doing it from the first, and they are doing it most carefully to-day; and I don't believe there is an electric lighting company, doing business in New England, a parent company, who would willingly withdraw their support from our inspection bureau to-day, because it has been demonstrated to them that they are reaping as much good from it as we are; and the result has been the absence of fires, the increase of confidence in insurance as to that mode of lighting; then a quite general reduction of rates, and, as a consequence, electric lighting is done to a very much greater degree in New England than any other part of the country. Why, in that little part of the United States, we have got over 200 electric light stations to-day. Every little town has its electric light stations, and the matter of insurance on those stations, while it has been very difficult in the past to get many of them insured, I think to-day and within the next six months, there will be no difficulty whatever in getting all of the insurance that is wanted from any of the companies and at reasonable rates. I have personally examined nearly every one of them. I found scarcely a station but what was defective, and many of them seriously defective, according to our idea, as fire risks. But, on the other hand, I find no opposition whatever, but the greatest willingness on the part of the owners of the stations to make any alterations whatever that would improve the station as a fire risk, because, they say, all of them, it not only

interests you; it is not only for your interest to have our station a safe risk, free from fire, but our interest is twice as much as yours. If there is any interest in the world that does not want a fire, it is the electric light station. If there is any class of business that can't afford to have a fire, it is the electric light business, for many reasons. In the first place, no loss that can be paid by insurance companies can indemnify them against any loss. A great part of their plant of value it is utterly impossible to destroy by fire. They are under contract to furnish light and power from day to day, and a suspension of their business would be ten times the loss that would be represented in money value. And for those reasons we find that in New England the greatest willingness exists, as I have stated, on the part of the electric light station owners to make any changes whatever. The result is that there is scarcely a station in New England to-day but is undergoing changes, and the stations to-day are rated, I think the average rate upon them would be something about 2½ per cent. in the present condition. In less than six months from now I predict that the average rate on stations in New England will be nearly one per cent. We have written lots of them to-day at 75 cents, and some most elegant stations are being built, and no less than 20 of the most modern stations are going up to-day. The work of perfection seems to have taken the strongest hold with us, and every electric light company that is contemplating building stations to-day, is trying to do it in accordance with the standard that we have established, and some of them are even going past our standard; and, as Mr. Henthorne, when he comes to his paper, will show you, there is a station in Providence that is almost non-combustible, and one in Waterbury almost on the same principle. It is just as easy to build them that way, and that is the tendency to-day. Of course, it is an important interest to you and important to us because, as Mr. Anderson says, if there is a dollar in any class of business the insurance companies want it, and they are after it. I think the companies will be made to see it within a year, and I predict that within that time there will be no trouble whatever in getting insurance on the stations. If there is not, I can see no other method than the method proposed by Mr. Morrison, of getting at it through mutual insurance. I believe that the

electric light stations can be and will be made a good insurable risk, and they only want to go to work about it and make them as safe as they are capable of being made. Therefore, I will repeat my amendment again, that this Committee on Harmonizing the Electric Light and Insurance Interests be continued and requested to take into consideration the subject of mutual insurance, and, also, that they be requested to invite representatives of the various insurance organizations to meet them at such time and place as they may designate, for the purpose of coming at something tangible and bringing about a system of inspection and examination such as is carried on by the New England Electrical Exchange, with a view of lessening the hazard and making it as near perfect as possible.

MR. MORRISON: I want to call the attention of the members of the Association to the fact that the proposition to establish a mutual insurance company within the Association is not new. On the 10th day of February, 1886, at the Baltimore Convention, a proposition of a similar character was introduced. I am not going to take up any time of the Convention, except to suggest to the members that they refer to the back numbers of the Official Report to see what action was had. I was opposed to it then and am opposed to it now. When you come to the fourth meeting of this body, held in Detroit, Mich., you will find there that a committee appointed at a previous meeting to look into this question, through their chairman, Mr. C. H. Woodbury, an insurance expert, reported adversely on the mutual insurance project, and it died. Mr. H. M. Cleveland was the originator of the idea of mutual insurance within the National Electric Light Association. There were a number of gentlemen who were ready to organize and operate an association of that kind for the benefit of the Association, I take it. The investigation which followed determined then that it was not a wise thing for the National Electric Light Association to take any steps in this direction. I believe that every man should mind his own business, if he can, and to that end, I think insurance people should attend to the insurance and the electric light people to the making of light. I think the Jack-of-all-trades is master of none. When you go into a foreign field you have either got to learn the business yourself, or buy the services of some man who

already knows it. A man who has got sense enough to understand the electric station business is too old to learn anything else, I take it; and if you go into that business you have got to take men who are doing it for themselves. I arose to refer the members of the Association to these two items of history, the history of their own Association; and when you read these you will find what has been done in the past, and that may, perhaps, to some extent, govern your actions in the future. I have very little to say on the question of insurance, for I had my say in our companies; that is, the companies with which I am connected in the State of Maryland. We cannot insure at all. Our stations are so built and equipped that there is little or no danger of fire. We have men patroling them all the time, day and night; the buildings are almost fireproof. If I had an old tumble-down shanty like a good many of you, I should want to be insured, too. I find that a successful company never has a fire; but you take a company that is losing three or four thousand dollars a month, and a fire is a Godsend to them. But you take a first-class station, and you have a good business, and, of course, the laws of business require you to insure. We insure; I think our insurance is about one per cent.—one and a half per cent. It is a matter that I give very little attention to. I don't bother my head about it. We are insured for a considerable amount; I don't remember how much it is. We applied for insurance on a station, one-half of which is built of wood. The insurance men come along and looked it over and said, you have got to make some radical alterations, and they amounted to $640. The original insurance, I think, on the structure amounted to nearly that much per annum in premiums. We made the changes they suggested, had hose put in, made connection with pumps, and they insured us for one and a half per cent.

Now, I see no difficulty, so far as we are concerned, with insurance companies at all. I look upon them like a man sitting down at a faro bank trying to get something for nothing; and it is only by accident or Divine Providence that the bank is kept from beating you.

So I want to put myself on record here now, with the light that I at present possess. I don't mean to say that my opinions cannot be changed because I have already confessed to you a

good bit of ignorance on this point. At the time when I declared my opposition to an insurance company within the lines of the National Electric Light Association I had certain information. I have no additional information which has caused me to change my opinion. I am opposed to-day to the National Electric Light Assosiation going into the insurance business. Let them take care of their own affairs. If there is a case of injustice, I take it, through this very committee, if it continues to do the work in the next six months that it has done in the past, a better condition of things will obtain, and that such a condition of affairs as Mr. De Camp suggests will be a very rare occurrence. Mr. De Camp's station is what Mr. Law called an ideal station, I think.

Mr. Law: The station is not an ideal station which we possess to-day.

Mr. Morrison: I thought you gave us a very good description of the Philadelphia station.

Mr. Law: Two stories high, that is all.

Mr. Morrison: I thought from his statement that an unjust act had been committed by the insurance people. I do not believe that a case of that kind, when it involves so many facts behind it, and so much property that is insurable and get-at-able by the insurance companies—an isolated station, as Mr. Lynch suggests. When this is brought here prominently before the insurance people, that matter will be taken up. I do not believe that Mr. De Camp will have that to complain of, because if the Philadelphia men are so careful, he will find somebody else to step in there and take the risk, if it is a safe one, and if the owners of the building comply with the requirements of the insurance companies, I will undertake to get you insured at a much cheaper rate than at present.

Mr. Francisco: If I had closed my eyes and heard Mr. Morrison talk I should have thought I was attending a meeting of some adjustors of losses, he hits the point so completely and exactly in his theory in regard to this mutual insurance. My experience has been that if you make a risk proper and right in every respect, that stock insurance companies will give you rates just as cheap as you can get it in the mutual. If you are going to run a mutual insurance company you have got to do it on the

same principle as they do. Members of this company don't want to pay some poor station when they can get their own station insured in some other company. You have got to have money enough to pay your expenses. If you put your stations in proper shape you can get a stock company to carry it. Now, as an illustration, take my own station. Before I took charge of it they could not get insurance; now I am getting it at one and a quarter per cent., and I made the changes required by the insurance companies under the basis of the New England Exchange. I could make additions to it by which I could reduce that rate, and it has been my experience that if you put your stations in proper shape the stock companies will make your rate as low as any mutual company can.

MR. MORRISON: I understood from some of the gentlemen representing insurance interests that a large number of leading insurance companies in the country were deciding that they would not insure electric light stations at all, simply because they were electric light stations,. If we are driven to that point, it is proper that this committee should consider the advisability of the idea—that is all I want—of knowing whether we can have a co-operative or mutual insurance company, that is all. I am not asking this because I wish to go into the business of insuring. I have read that somewhere in New England, in the cotton mills, at one time, finding the rates of insurance unsatisfactory, they adopted a mutual plan by which they insured their own mills, and my information has been that the plan was eminently successful; and they did their own business cheaper than they could get it done by the insurance companies, and I am informed it is existing to-day. Of course, I would not go into it and put my station in and agree to pay anything if you are going along and take indiscriminately every station that is offered. I would insist upon it being confined to such stations as Mr. De Camp's, Mr. Morrison's, and the one we are now building and some others, and make the discrimination that the insurance companies fail to make themselves. I only want a report upon the feasibility of the idea and let the men present all the statistics and data they can get on the subject.

THE PRESIDENT:. I see no objection to the amendment as offered. I think that our relief must come from ourselves. The

insurance companies must act upon general principles; they must deal with generalities, and we should not condemn them, because from our experience with the whole class, they say that they cannot afford to carry that class because they would not make exceptions of individuals within that class. I think that the New England Board is on the right line, and that our relief must come from the hearty co-operation with insurance interests towards establishing similar exchanges throughout the country; and, as I said, I see no objection to continuing the committee if the amendment is accepted by Mr. Morrison. Are you ready for the question? (Cries of "Question.") The motion is, that the Report of the Committee on Harmonizing the Electrical and Insurance Interests be received and filed, and the committee continued, with instructions to take under advisement the feasibility of establishing a mutual insurance company. All in favor of this motion will please signify by saying aye.

MR. MORRISON: You have not stated the motion completely.

MR. BARTON: You have omitted my amendment, which I stated at considerable length. I will try and condense it. That the committee also invite representatives of the insurance interests to meet them at such time and place as they may designate, with a view to taking some tangible action looking to inspection and the establishment of electrical exchanges to cover the whole country.

THE PRESIDENT: If there is no objection, the Chair will consider the vote thus taken to include this. (After a pause.) There appearing none, it is so ordered.

MR. MORRISON: Did you call the negative?

THE PRESIDENT: I did so. There were no negatives.

MR. MORRISON: I did not hear it. There will be one negative when you call it. I only wish it should not appear as a unanimous vote of the Convention.

THE PRESIDENT: There is one vote in the negative. We will next hear from Mr. Henthorne, on the Ideal Electric Light Central Station.

MR. CHARLES A. BROWN (of Chicago, Ill.): May I offer the following resolution, that a committee of three be appointed by the President, and instructed to prepare and present to the proper

committee of Congress a petition on behalf of The National Electric Light Association for the abolition of the customs duty on copper, ingot, wire plates, sheets, bars and rods.

MR. PHELPS: I second Mr. Brown's resolution, and move its adoption.

MR. MORRISON: I would like to hear that read once more.

Mr. Brown read the resolution.

MR. MORRISON: If we could get Congress to adopt that, I think that the work of the National Electric Light Association will have reached the point which will entitle it to the grateful remembrance of every citizen of this country who has the good of this country at heart.

MR. PHELPS: I have the floor, I think.

THE PRESIDENT: Mr. Morrison has the floor.

MR. MORRISON: I am delighted that it came from a gentleman from Chicago. I would be glad if every gentleman engaged in other lines of business that impinge on our affairs would present precisely a similar case, and nothing would give me greater pleasure than to welcome Mr. Brown and his colleagues into the ranks of Free Traders.

MR. PHELPS: I rose to second Mr. Brown's resolution and say a few words. I am very glad that Mr. Morrison has proceeded with such a hearty commendation of the resolution. It does not seem to me at all certain and, in fact, very probably not very likely that the adoption of this resolution would secure the abolition of the copper tariff next winter, but it would be a move in that direction. Those who have read attentively the public journals on the subject of the copper tariff may observe that even protectionist journals realize that this is a tariff which ought to go. It seems to me eminently proper that this body should memorialize Congress on this subject, in view of the immense proportion that copper bears to all electric plants. I have not at this time the precise figures on that point, but it is my impression that copper enters into the cost of electric plants in general to the extent of at least one-third, perhaps more. And the further reason that I have is this, that whatever will reduce materially the cost of electric plants, will indirectly, if not directly, increase your business, the business that the people of this Association are engaged in. All are desirous of bringing

the production of electric light down to as low a cost as possible, and the cost of the initial plant is a very large proportion of the cost of production. And therefore, I have risen to second this resolution. It is a move toward the future prosperity of electrical interests; and we have good reasons for taking it up, and a good reason in the condition of affairs is because the tariff is a useless tariff, and the copper men themselves say that they can make their copper for six or seven cents per pound; and while the present differences in prices in this country and Europe are not greatly pressing, we know what it has been through the lack of competition that has been existing for several years; and this tariff is the most powerful instrument in behalf of those who went to use it for future speculations.

MR. MORRISON: I move, as an amendment, that it be referred to the Committee on State Legislation.

MR. PHELPS: That is a Committee on State and Municipal Legislation.

MR. MORRISON: I think the members would like to hear especially upon this subject from the members. There is nothing more important than this; let us have a vote on it.

MR. S. S. LEONARD: I move the resolution offered by Mr. Brown lie on the table.

THE PRESIDENT: The motion of Mr. Leonard (of Minneapolis), to lay on the table, is the question before the house.

MR. PHELPS: I hope that it will not be laid on the table. If it is laid on the table it will lie there until after the Convention is adjourned. It seems to me that the Convention might brace-up and make up its mind whether to adopt this resolution or not in a short time.

THE PRESIDENT: Are you ready for the question?

MR. MORRISON: The motion to lay on the table is always offered to evade. The little joke which I made awhile ago and which failed so dismally is due to a thickness of the understanding of the gentleman and not to a lack of point to my joke. So I hope the gentleman, through his stanch adherance to the doctrine that the inherited will not succeed, because the new generation don't revive that sort of thing. That doctrine will not stand in the way of adopting a resolution, and it was intended for the benefit of men in our business. The copper is made in

this country; the tariff has no effect whatever; in this country we can make copper cheaper than they can make it in Europe. Just like tin plate. They don't make a sheet of tin plate in this country, and yet they pay the tariff. I want to get rid of that; just put the thing dead square; it is a measure to benefit yourselves, and don't let any old fogy ideas stand in between you and your pocket-book. People will have a good deal more respect for you for doing so than if you did not do so in order to maintain your political integrity.

THE PRESIDENT: I am a protectionist, but I believe first in protecting ourselves, and the resolution, as offered by the gentleman from Chicago, it seems to me, is right in line of the protection of the electrical industries of this country. I think that we should protect ourselves, not only against our foreign cousins, but against our home friends and relatives, at certain times, and I think this is one of the times. Are you ready for the question?

MR. S. S. LEONARD: My object in making that motion is simply to see if we could not do away with debate on this question, and see if we could not have it settled; and we are not going to settle the tariff question to-day. I should like to hear more about an ideal central station than the tariff business; but if it will shorten the matter any, I will withdraw that motion; anything to help the matter along.

THE PRESIDENT: Are you ready for the question, that the resolution and preamble be referred to the committee of three?

The question was called for.

The President put the question and declared it adopted, and appointed on the committee Messrs. Brown, Phelps and Morrison.

THE PRESIDENT: We will now hear from Mr. Henthorne on An Ideal Electric Light Central Station, from a Mechanical Standpoint.

Mr. Henthorne then read the following paper:

NEW CENTRAL STATION, NARRAGANSETT ELECTRIC LIGHTING COMPANY, PROVIDENCE, R. I.

MARSDEN J. PERRY, VICE-PRESIDENT AND GENERAL MANAGER.

DESIGNED AND SUPERVISED BY REMINGTON & HENTHORNE, MECHANICAL ENGINEERS AND ARCHITECTS, PROVIDENCE, R. I.

It is, without doubt, generally conceded by the managers of electric lighting stations that the main, if not the vital, practical problem ever present for their consideration is how to best reduce the cost of the running expenses of the station. We state this advisedly because the stage of doubt and uncertainty coupled with experiment has long since passed, and the business of producing electricity commercially is one of the leading interests of to-day, not only in this country, but in the world at large, and is being rapidly extended.

The reasons why it is so desirable to lessen the cost of the production of electricity will readily suggest themselves to the practical mind. We would, however, venture the opinion that one, but not the least one, may be found in the desire to increase the earnings which is returned to the stockholders with more or less frequency, in the form of dividends.

In view of this condition of things pertaining to matters electrical at the time to which our attention was attracted to this subject, we at once gave the matter a serious consideration and came to the conclusion that for the present, at least, the most needed and radical improvements should bear directly upon the steam plant and also to the mechanism employed in transmitting the power thus generated to the dynamos.

At or about the time to which we have just alluded, M. J. Perry, Esq., the efficient General Manager of the Narragansett Electric Lighting Company, of Providence, R. I., commissioned us to design and plan the arrangement of the entire motive power and machinery, as well as the buildings and chimney necessary to the completion of a proposed first-class electric lighting station, which might be expanded to an ultimate capacity of some 12,000 horse-power.

The site for the new station is on the west side of the Providence River, and just north of the Point Street Bridge. The lot comprises some 55,000 square feet of land, bounded on the north and south sides by public streets, and a water front forming the east side.

In the preliminary plan, which was afterwards adopted, the new station was represented as having two dynamo buildings, each 60x200 feet, one on each street. The number of dynamos to be provided for in each building being about 80 of an average capacity of 50 to 60 lights. The dynamo houses being united along the west side or end by a building used for offices, store houses, etc.

The dynamos are so arranged that a much greater number than usual are located in a given floor space. Notwithstanding that this statement might lead

one to infer that the machines are too compactly placed, there is still left ample room for ready adjustment, inspection, etc. All the dynamos in each building are driven direct from pulleys rigidly secured to a main line shaft located below the dynamo room floor. It will be seen that this arrangement of buildings forms a hollow square, open on the east side. In this space, which is covered by a well lighted and ventilated roof, are located the engines.

In view of the fact that the employment of the best type of compound engines is being constantly extended to effect a considerable saving of steam (or fuel), it was decided to adopt for the station triple expansion compound engines provided with independent surface condensers and circulating pumps. The initial steam pressure being 160 pounds.

As the lot has a water frontage of sufficient depth to allow vessels to lie alongside, it was decided to locate the boiler house on that side, the plan being to discharge the coal from the vessels directly into coal pockets of large capacity built into the roof of the house, from which, by a series of suitably arranged chutes and pipes, the coal is delivered by gravity to the front of the boilers.

The water tube type of boiler was selected as possessing greater advantages over other styles of boilers, and also from the fact that a working pressure of 160 pounds would be required.

To the rear of each battery of boilers is located, in the main flue, an economizer for increasing the temperature of the feed water. By means of short branch flues provided with dampers the economizer may be cut out as desired, and the waste gases pass directly to the chimney. It is the intention to introduce mechanical stokers soon. When thus equipped, the labor required to handle the fuel will be reduced to a minimum.

The chimney is made sufficiently large to produce ample draft for the entire series of boilers. It is located directly west of the boiler house and adjacent to it, and extends through the engine house roof. The size of the flue itself being 14 feet diameter and some 235 feet high above engine room floor.

By means of the machinery, etc., thus outlined together with others of special design, all of which will be hereinafter described, it is confidently expected that the actual cost of the mechanical generation of electricity will be reduced to a lower figure than any other station having substantially the same capacity.

The buildings constructed thus far and what was deemed of sufficient capacity for the present with a large margin for growth, is a dynamo house 200 feet long and 60 feet wide, facing upon Elm street; a boiler house 71 feet 10 inches wide inside and 68 feet long, running lengthwise and directly on the Providence River, which is of ample capacity to develop 4,000 indicated horse-power by the engines, and an engine house 57 feet wide and 110 feet long. These structures are of brick or plain design, having granite underpinning and brown stone sills for the windows, and may be considered practically fireproof, as the only wood entering into their construction is that of the window frames and floor. The chimney, although not as yet finished, is

of 14 feet internal diameter, 28 feet 6 inches square at the base, and 238 feet high from high water line; this structure alone requiring 1,500,000 bricks.

The plan of these several buildings is shown on Sheet No. 1 and is represented by full lines, while the dotted lines represent a similar building upon the South street side, with an engine room intervening, ultimately to be 73 feet by 200 feet long in the clear without any posts, and the boiler house extended the full width of the lot or 71 feet 10 inches by 200 feet, when eventually carried out as necessity demands. It will, therefore, be seen that ample provisions for extension have been made, and which may be carried out without in any way interfering with the regular daily operations of the station, or undoing what has been done on the permanent structures. The end and side wall of the engine house, and also the end of the boiler house, are of a temporary nature, although built of brick.

DYNAMO HOUSE FOUNDATIONS.

The character of the foundation which we had to deal with through all of the work of construction, was that which one would naturally expect in dealing with a public dumping ground, which, while forming a very solid upper crust was overlaying a strata of dock mud and blue clay, which, when once entered, was as unstaple as oil; underlying this was sand, and finally hard pan was reached at a depth varying from 35 feet to 50 feet below high water.

The unreliability of this material determined that piling should be driven for all of the permanent walls of the buildings, and the specifications for the dynamo house foundations, which were the first started upon, were so drawn that piles of 30 feet in length, increasing towards the river to 45 feet in length, should be driven, and the whole, which were of spruce, and each being 11 inches diameter, were cut off 36 inches below established high water. These piles, 216 in number, were driven alternately in two rows 32 inches center to center at right angles to the wall, and 64 inches center to center parallel with the wall, each row being surmounted by 12 x 12 inch. hard pine timber pile caps. Upon these caps was started the masonry wall 4 feet 3 inches wide at the base, tapering to 24 inches at the top, on the four foot level above high water. This wall was, as for all others, laid in cement mortar in the proportion of one cement to two of sand.

The assumption as to the length of the piles to be driven proved, from the nature of the surroundings, to be correct, as when driven at the farthest or west point from the river, hard pan was reached at a level of from 35 feet to 38 feet below mean high water, and from this point towards the shore the strata gradually dipped to a level ranging from 50 feet to 53 feet below high water. This piling is shown on Sheet 16.

DYNAMO HOUSE.

The walls of the dynamo house are as before stated 60 feet wide in the clear and 200 feet long, and are 20 inches thick from the foundation up to the level of the dynamo floor, which is about 7 feet, 9 inches above the average grade of the sidewalk, thence it is reduced in thickness by a pressed brick belt course to 16 inches, and carried up to the 29 feet, 3 inch level, thus leaving 17 feet from the dynamo floor to the under side of the wrought iron trusses.

The house is covered by a wrought iron truss roof made by the Berlin Iron Bridge Company, East Berlin, Connecticut.

The trusses are placed 10 feet center to center, the rafters of which are made up of 10-inch plate iron with 2-inch by 2-inch angles riveted thereto, and the lower chord of 2-inch by 2½-inch angles, the struts or braces are 2-inch and 1¾-inch angles. The purlins running lengthwise with the building are of 2-inch by 2-inch angles, spaced 25½-inch centers, and upon which is placed the roof covering.

Upon the roof is a ventilator 8 feet wide and 5 feet high running 170 feet longtitudinally of the building; to the sides of the ventilator are bolted double glazed windows so arranged as to be opened from below for ventilation. There are three half panels on each side of the monitor which are covered with corrugated iron, the remaining portions of the sides and also of the ends being of glass.

In the design of the building no attempt was made at ornamentation, the main object being to provide ample light and ventilation in connection with means for properly and economically caring for the machinery placed therein.

To prevent any condensation from taking place on the under side of the iron roof, due to the difference in temperature, within and without, which would be extremely objectionable and dangerous in buildings used for this purpose, the following described non-conducting covering was devised. Upon the purlins of the roof is first tightly stretched galvanized iron wire netting of two inches octagonal mesh, thus forming a foundation upon which to place two layers of asbestos board, the edges of each sheet overlapping about two inches on its neighbor, the two layers break joints with each other. On this is laid a covering of tarred paper mopped over with hot asphaltum, and finally a second layer of tarred paper is applied and also breaking joints with the lower layer upon the hot asphaltum, thus completing what is intended to be a dry and incombustible sheathing, and finally upon the whole is then placed the No. 24 galvanized corrugated covering, the same bein; secured every five inches fore and aft to the purlins below.

This roof covering is shown on Sheet No. 6.

DYNAMOS.

In the general layout of the dynamos, provision has been made for placing four rows on each side of the center line of the house, the dynamos are placed diagonally with each other in sections or blocks of four, as shown on Sheet 7.

Each machine is supported upon a substantial brick foundation laid up with cement, the several 12-inch walls forming the foundations of each series are bonded together, and in fact all built at one time, so that the foundation for one machine acts as a brace for its neighbor.

Between these foundations and the walls of the building is a wooden floor of ordinary mill construction.

Directly beneath each machine is left open a section of floor for a thorough

ventilation of the armature, through the medium of the cool, although perfectly dry, basement below.

All of the dynamos are belted down through the floor to pulleys rigidly secured to the main shaft, the machines being started or stopped at will by an appliance hereinafter described.

The ultimate capacity of this first dynamo house of the station will be about 80 machines of the ordinary 50 or 60 light size, although much more power may be installed by the introduction of machines of greater capacity than that represented above.

The station will be started with about 35 or 40 machines in service, and when enlargement becomes necessary, from time to time, the line shaft will be extended as desired and the available floor space left for that purpose will then be utilized.

The dynamo room is thoroughly lighted on the sides and ends by large windows, all of which, excepting those on the south side or engine room side are of three sashes; the combined height being 10 feet and the width, 4 feet 8 inches. The windows are placed 10 feet, center to center, and the sills 23 inches above the dynamo floor, and being sufficiently low to influence the proper ventilation of the dynamos.

CRANE.

Directly underneath each truss of the dynamo room and bolted thereto is built in each side wall a chair or casting for supporting the tracks for the traveling crane, which was deemed essential for moving the dynamo machines from one location to another in an expeditious and economical manner.

These tracks are of nine-inch rolled beams weighing 70 pounds per yard, and were cut in 20 feet sections, the bottom flange being bolted to the cast iron chair and the ends strapped together by a plate and bolted.

The box girder proper was constructed by the Berlin Iron Bridge Company, and is 58 feet in length, end to end, and made up of two plates 30 inches deep, stayed and stiffened on the sides by ¼-inch gusset plates riveted between two 3x3-inch vertical angles on the plate girder. Across the top is placed at a corresponding distance (5 feet 5 inches) two 4x3-inch angles, six feet long, to which also are riveted the gusset plates. At the top to the vertical plate on the outside, and at the bottom on the inside, are riveted 4x3½-inch angle irons. The lower angles forming the track for the trolley, which runs lengthwise with the crane.

The sides of the girder are further stiffened and braced by a system of 3x2-inch diagonal angles, all of which, by reference to Sheets 8 and 9, will be clearly defined. Each end of the girder rests in a cast iron chair, and is bolted and riveted thereto. At the extreme end of this supporting chair are located, 72 inches apart, the friction roller wheels which support the whole, and by means of a shaft operated by a chain from below and a system of spur gearing acting upon one friction roller wheel at each end of the supporting chair, the whole is propelled lengthwise of the building. A chain is also used to propel the trolley across the building or lengthwise of the box girder. The whole were made from plans designed by us.

BELT SHIFTER.

The device adopted for shifting the dynamo belt is such that loose pulleys and clutches are entirely dispensed with. The pulleys being rigidly secured to the shaft. The arrangement consists (for each dynamo-driving pulley, the same being 60 inches in diameter) of a curved standard or frame secured and extending up from the floor somewhat above the center of the shaft. Each side of the frame is provided with a series of narrow guide-rolls, the centers of which are arranged in a half-circle whose diameter is somewhat less than that of the pulley. The curved frame in cross section being U shape; the pulley continuously revolving in the space lying between the two sides.

To the rear of the 60-inch pulley, between it and the dynamo and intermediate of the upper and lower side of the belt, is mounted a short shaft parallel with the main shaft having two chain wheels thereon, separated from each other by a distance exceeding the width of the pulley. Two endless chains (made up of flat links) are carried by this shaft, and supported by the guide-rolls before referred to. A portion of the chains or flexible apron is provided with two-inch wooden rolls, the same extending across and uniting the two chains; the under side of the rolls being some half inch or more above the periphery of the pulley when the belt is shifted.

In order to shift the belt, the dynamo is first operated by the usual screw or equivalent device to slacken the belt somewhat, to be immediately followed by operating a lever which carries the wooden rolls ahead from the normal position, thereby engaging the inner face of the belt, and as the chain advances lifts the belt radially away from the pulley, the belt then being stationary and the pulley revolving.

To start the dynamo the operation is reversed, that is, the flexible apron is revolved rearwardly, thereby carrying the rolls from the proximity of the pulley and allowing the belt to reengage the pulley; the dynamos at the same time being actuated to tighten the belt. This device is indicated on Sheet No. 10.

ENGINE HOUSE.

The engine room as at present completed is 57 feet wide and about 110 feet long and covered by an iron truss roof, also made by the Berlin Iron Bridge Company, and of practically the same design and non-conducting covering as for the dynamo house. When necessity demands, the house will be lengthened by the removal of the temporary end parti-wall and the extension of the present iron roof up to the West end of the dynamo house.

The change above contemplated will then accommodate sufficient engine capacity for the first dynamo building, and upon the ultimate addition of the second dynamo house upon South street, the engine room will become about 73 feet wide and without any posts. To accommodate this additional width, provision was made in this present roof for splicing out the trusses, and thus the two sides of the roof would then become alike. This can be done without at all affecting the operation of the station, a condition throughout the entire work which we have always carefully considered.

Below the floor is located the first leg of the 26-inch exhaust pipe, and above and supported upon the wrought iron trusses is the 18-inch wrought iron steam pipe. These two pipe lines will ultimately form a U shape, that is passing up one side of the room and returning down the other.

ENGINE.

The engine, which is of the triple-expansion type, was especially designed for the service of the station by E. Reynolds, General Superintendent of E. P. Allis & Company, of Milwaukee, Wisconsin.

The high pressure cylinder of the engine being 14 inches in diameter, the intermediate cylinder 25 inches in diameter and the low pressure cylinder 33 inches diameter, each 48-inch stroke.

The working barrels of each cylinder, together with the heads, are thoroughly jacketed with steam at boiler pressure, also the receiver between the high and intermediate cylinders, and that between the intermediate and low pressure cylinders are likewise jacketed by steam at boiler pressure.

The valves of all the cylinders are located in the heads, and as the working faces of the valve with this construction are within a very short distance from the face of the heads, the waste clearances are reduced to a minimum.

The valve gear is of the liberating type, the valves themselves closing by vacuum-pots located level with the engine room floor.

The automatic cut-off mechanism of the first and intermediate cylinders are actuated by and under the control of the governor, and at the same time the point of cut-off of the intermediate cylinder may be set at a fixed point independent of the governor, if it is so desired. While, for the large cylinder the point of cut-off is fixed by hand adjustment and always independent of the action of the governor, and thus a perfect means is afforded to adjust the ratio of expansion relatively in each cylinder and effect the greatest possible economy of steam and, consequently, fuel.

For the first and intermediate cylinders one eccentric is employed to operate their valve-gear and for the large cylinder one eccentric is used to operate the two steam valves and one for the two exhaust valves.

The object and advantage of this arrangement being to obtain any amount of compression that may be found desirable, independent of the action of the steam valve.

The diameter of the main driving wheel is 17 feet and of 45-inch face, made in segments and carrying a 44-inch double belt made by Messrs. C. A. Scherin & Co., of New York.

The jackets of the two receivers and of the three steam cylinders are drained by a pump three inches in diameter and five-inch stroke, operated from the condenser of the engine, the water being pumped into the feed pipe.

The frame of the engine is one peculiar to the builders and was first designed for heavy rolling mill practice and consists of strong wrought iron bars or rods running from the cylinder head to the pillow block. The rods tie these two parts together and at the same time form a part of the guide-rod for the horizontal cross-head. From each cross-head extend two ham-

mered iron piston rods for the intermediate cylinder and large cylinder, and for the small cylinder one rod passes through the back head of the intermediate.

The speed of the engine is 100 revolutions per minute. To provide efficient lubrication for the main bearings, a positive oil circulation is produced by a pump operated from the valve-gear rocker shaft.

CONDENSER, ETC.

The condensing apparatus for the engines of the station will be arranged in series, *i. e.*, it will consist of several surface condensers and combined air and circulating pumps working upon one large exhaust main which is common to all engines of the station.

This plan was adopted, after some deliberation, for the reason that any particular surface condenser or a number of such with its independent motive power for driving the pump of the same, can be operated at will with the result of producing the desired vacuum upon the exhaust main. As all of the engines are connected to this exhaust main and are shut out at pleasure, therefore, it follows that any individual engine is not restricted in its operation to the running of any condensing apparatus in the station.

Electric light stations, as we all know, are subject to wide variations in power during a period of 24 hours, and to economize power in the operation of the air and circulating pumps of the condensers, we have selected a cut-off engine as the motive power for the condensing apparatus, the point of cut-off of this engine being controlled by the vacuum in the surface condenser. As the load upon the main engines is increased, the natural tendency in the action of the surface condenser results in a decrease in the vacuum by a consequent rise in the temperature of the overflow water, due to the introduction of a larger volume of exhaust steam into the condenser. This decrease in vacuum immediately acts upon the cut-off mechanism of the engine of the condensing apparatus, and by allowing the steam in the cylinder to follow farther upon the stroke before cutting-off, the engine increases in speed, and thus delivers a greater volume of circulating water to the condenser, and at the same time correspondingly increases the volume of discharge from the air pumps. An opposite action results from a diminution of the load on the main engine and correspondingly stows down the condensing engine.

The first condenser put in is 9 feet long, 6 feet wide and 8 feet high, and contains 2,496 square feet of cooling surface. These tubes, which are $\frac{13}{16}$-inch and $1\frac{1}{4}$-inch in diameter, placed one inside of the other, are suspended vertically from brass plates with their upper ends expanded therein. The plates for supporting the smaller tubes being some 8 inches above those for the larger or cooling pipes, as per Sheet 19.

These tubes are arranged in six sections of 208 pair to a section, the water of condensation passing downward through the $\frac{13}{16}$-inch tubes, thence upward between the large and smaller tubes, where it then crosses over to the next section, passing downward through the large tube and upward through the

smaller tubes, where it again passes forward, the operation being repeated until the water has traversed the six sections, when, finally, it passes overboard to the river by an 18-inch cast iron pipe, whose end is submerged about four feet below low water and, consequently, acting as one leg of a syphon.

The injection pipe is laid in South street, 200 feet south of the overflow, and commences at a well having three screen chambers leading therefrom to the river. The screens being covered with ¼-inch and $\frac{3}{16}$-inch copper wire.

The condensing apparatus engine is 12-inch diameter and 16-inch stroke, with liberating valve-gear, and of the same pattern as the large engine. The air and salt water circulating pumps are, respectively, 24-inch and 16-inch diameter, each of 16-inch stroke.

Intermediate of the air and circulating pumps is located on the overhead crank shaft a plain fly-wheel, 10 feet in diameter, the center of the shaft being 10 feet, 1 inch above the floor.

AUTOMATIC BOILER FEEDING MECHANISM.

Upon the opposite end of the shaft of the condensing apparatus engine is located the feed pump. The pump has an automatic device for controling its stroke by the height of the water in the boiler, and thus the stroke of the feed pump is automatically lengthened or shortened, as the case may be, to correspond with the actual quantity of water evaporated in the several boilers.

With this device we are enabled to run the pump at its full capacity even though its stroke may be from 0 up to 16 inches, without the use of a "by-pass," and thus at times save considerable power. This device consists of a float mounted in the boiler and operating a balanced valve in the feed pipe line which, by an increase in pressure in the feed pipe, due to an excessive height of water in the boiler, causes the closing of the balance valve, a reaction then takes place upon a differential water cylinder, and the movement due to this increase in pressure upon the piston contained therein shortens the stroke of the feed pump. A decrease in water level in the boilers has the effect of opening the balance valve of the feed pump wider, which momentarily has the effect to reduce the pressure therein, and this reaction upon the differential piston acts to lengthen the stroke of the feed pump and, consequently, discharges more water, as required by the increased evaporation.

STEAM PIPE.

In a station of the proposed capacity of ours it becomes absolutely essential that the main line of steam pipe should be so constructed that full boiler pressure can be maintained upon it during every moment of the year, and to avoid any possibilities of leakage, which would prevent its use at any time, we have so arranged all joints in the main line that if any leakages should occur it may readily be remedied without removing the steam pressure therefrom.

The main line of pipe is 18 inches inside diameter, and was made from our designs by the Continental Iron Works, of Brooklyn, N. Y., and is of ½-inch steel plate with the horizontal seams welded, while at the ends, for con-

necting the various lengths together, a bell flange was turned out from the material of the pipe itself, as shown at Sheet 11. These flanges were then double riveted together, and the joint calked up against its neighboring flange from the outside. Where a wrought iron pipe joins a cast outlet or inlet tee, or to an elbow, they were likewise riveted to the cast iron flange, as shown, and the joint made tight by calking the bevel edge of the wrought iron flange against the cast iron. This also admits of recalking, should it become necessary at any time to do so, without removing the pressure from the pipe. The flange joints of all of the cast iron pipe in the main line are made with male and female joints as shown, and into the recess of which is placed a gasket of vulcanized asbestos. The flanges are then bolted together with ⅞-inch bolts spaced about 4.4 inches, center to center.

At each outlet and inlet and directly upon the main line, is placed an open way Chapman valve having brass seats. The flanges of these valves are likewise provided with a male and female joint, so as to prevent any possibility of the joint blowing out.

The piping upon the main line beyond these valves is of ordinary lap-welded tubes having screwed ends, fitting standard flanges and cast iron elbows. Should any section of this primary pipe leak at any time, it can be repaired by shutting it out by means of the valves above referred to, located in the main line.

The 18-inch main steam line will run along each side of the engine room house and at its extreme ends the two lines will join and thus form a U for feeding all engines proposed for the station. Steam in the meantime being taken from the boilers into each end of the pipe.

Ample provisions are made for removing all water of condensation from the pipe by collecting it into cast iron wells having water glasses thereon, and then trapped into the feed water tank, from whence it is pumped back into the boilers.

SHAFTING.

The engines are belted down to jack pulleys secured upon open-hearth cast steel hollow shafts, through which freely passes and revolves the six-inch hammered iron line shaft.

On one end of the hollow shaft is cast a head 24 inches in diameter and to which is bolted a 54-inch Hill friction clutch to transmit the power of the first engine of 500 horse-power.

As the hollow steel shaft is supported in earrings nine inches in diameter and independent of the line shaft, it follows that the engine and its jack pulley and, of course, the hollow shaft can be stopped at pleasure by throwing out the friction clutch and still allow the main line to revolve as usual, but without touching the inside surface of the hollow shaft.

In case that the main line is in operation and it is required to start up any engine it is merely necessary to put the engine in operation and throw in the friction clutch and consequently connect the whole firmly together.

Along-side of the clutch upon the end of the hollow shaft is still another, 60 inches in diameter and of 800 horse-power capacity. This clutch is provided so that the main line may be cut out at pleasure at that point.

All of the bearings in which the shafting revolves are of liberal length and provided with bronze ring oilers, some having three rings while others have but two. These rings encircle the shaft and revolve by contact therewith, thereby carrying a large quantity of oil from a chamber formed in the lower part of the pillow blocks to the upper surface of the shafts and thus provides ample lubrication, a feature very essential in view of the fact that the shafting is to run 300 revolutions per minute, and that the bearings, especially those of the hollow shafts, are of large diameter.

SEA WALL.

The most difficult portion of the foundations which was put in was experienced when we commenced that of the boiler-house wall upon the river front. This resulted from the fact that man had from time immemorial driven piles indiscriminately to replace those which had become worn out or broken under the several old wharves which had been in existence at this site.

When the former wharf (as we found at the acquisition of the property) was removed, preliminary excavations were made, and an attempt made to remove the old piles found thereunder; during this operation the fact was revealed that the piles were of a miscellaneous diameter and of different length, none of them being sufficient for our purposes of building upon, some pulling out quite easily while its neighbor would be broken in the attempt. This fact prompted us to drive all of the old piles thus left standing below the grade of the new ones which we wished to insert and thus get the old piles beyond a point so that they would not interfere with our platform which we proposed to place upon the head of the new piles. The piling upon this wall consisted of four rows spaced 30 inches, center to center, and parallel with the harbor line established by the city, the center of the cluster of piling being 6 feet 6 inches from the established harbor line.

In addition to these four lines of piling there was driven, at every alternate row inland and at right angles to the harbor line, a series of four piles spaced 4 feet 6 inches, 13 feet 6 inches and 17 feet 3 inches, respectively, from the inner row of piles, as shown in section at Sheet 12 and in plan at Sheet 13. These piles, which were of spruce, and of 11 inch diameter at the butt and 54 to 50 feet long, were driven down with a ram of 2,200 lbs., and followed up at the last by a follower until hard bottom was reached, which varied from 45 to 53 feet below high water.

They were then cut off uniformly 7 feet, 6 inches below established high water mark by a circular saw hung up in the ways of the driver and which was operated by the engine used for driving upon the floating scow. The number of new piles being 547. When this was accomplished, after the usual amount of damage to the several saws incident to the very frequent contacts with the stone ballast found below, the head of the piles were then surmounted by 10x10 spruce timbers and securely fastened to the head of each new pile driven by ¾-inch drift bolts. These timbers were alternately of 22 feet, and 8 feet, 6 inches in length. And finally, upon these pile caps, were securely pinned and closely laid six-inch spruce planks which thus formed a platform 26 feet wide and extending the whole length of the river wall.

Inasmuch as there were already in place a large amount of old piles, 288 in number, which had been redriven below the line of the new, Portland cement concrete thoroughly mixed in the proportion of one cement, two sand and one broken stone and gravel, was placed in bags and thoroughly rammed down between the new and upon the head of the old piles, and so left that when the six-inch spruce planking was placed upon the stringers of the new piles a bearing also would be had upon the old as well as upon the new, which is shown on Sheet 14.

Upon this timber platform which runs inland from the river 26 feet, as above stated, was built the wall proper for the boiler house and its surmounting coal pocket. The center of this wall, as we have before stated, is 6 feet, 6 inches from the harbor line and the stone foundations having a base of 8 feet was started upon this platform and well-bedded in cement, all bottom stones being laid as headers and of 8 feet in length. Above this the wall gradually tapered to 4 feet, 9 inches in thickness at the 4 feet, 8-inch level, this wall being laid up as other foundation walls for the station, with cement mortar of one part of cement to two parts sand. The face of the wall being thoroughly pointed up two and one-half inches deep with Portland cement.

This same construction of wall and four rows of piling was carried around the northeast corner of the house, as shown in elevation at Sheet 15, as far as the platform extended to prevent any liability of washing from the river. From this point for the remaining portions of the walls the piles were driven in three rows 16 inches center to center of caps and spaced 42 inches lengthwise with the wall. These were cut off 84 inches below high water and surmounted by a 12x12 hard pine stringer, as for the dynamo house.

In Sheet 14 a section of a portion of the north and the whole of the east walls is shown, its base being 4 feet 6 inches wide tapering up to 3 feet 6 inches wide at the four feet level. These walls were laid up in cement as for other underground sections.

BOILER HOUSE.

The first section of boiler house built is 68 feet long and 71 feet 10 inches wide, as shown on Sheet No. 4, to accommodate four sections of boilers, and is so arranged that it may be lengthened the full width of the lot as required, or ultimately it will be 200 feet long.

There are two rows of columns running lengthwise with the building, spaced 14 feet 3 inches, center to center, while across the house the center line of the two rows is 21 feet. Under each column are driven a cluster of 15 piles to a depth of 45 feet to 53 feet below high water, and upon these are built the cut granite piers for supporting the coal pocket.

The piling for side walls and piers was carried about 15 feet beyond the actual line of the boiler house, so that when the parti-wall is removed for extension the driving of additional piling will not disturb any of the permanent structures.

The walls of the house are 26 feet 1 inch above the floor, the first 5 feet 10

inches being 36 inches thick with granite underpinning, and the balance of 32 inches wall. Lengthwise with the house is an ash tunnel, 4 feet 6 inches wide and 6 feet 4 inches in the clear, in which is a tramway, and by means of a turn-table opposite each transverse tunnel leading directly underneath each boiler grate, the carts for collecting the ashes are traversed back and forth as they become filled.

Directly over the boilers will be stored the fuel for the station in a wrought iron coal pocket 25 feet in depth, and of a capacity for this first section of 2,500 tons. Being directly upon tide water the coal is taken from the vessel alongside of the building, and is landed at once to any section of the pocket. The coal, after being weighed in a movable machine, is deposited opposite to the furnace doors by gravity. The floor of the pocket being built on an incline to facilitate the discharge of the coal.

BOILERS.

The first section of 500 horse-power boilers for the station were made by the National Water Tube Boiler Company, of New Brunswick, N. J., and are, as the maker's name implies, of the water tube type. They are set in two batteries to a section, each of which are of 250 horse-power, upon the commercial basis of 30 pounds of water evaporated into dry steam per hour, and as the engine is guaranteed to develop an indicated horse-power for 12.6 pounds of water per hour, the boilers will, therefore, evaporate water enough to develop by the engine about 1,100 horse-power per section.

Each boiler of the section is made up of 144 steel tubes 4 inches in diameter and 16 feet long, the tubes terminating in the charcoal cast iron headers lying horizontally.

These several layers of headers are nippled together with 4½-inch steel tubes, and are finally connected to the saddles by five-inch nipples. Upon the top of each boiler of the section are placed three 36-inch steam and water drums made up of $\frac{7}{16}$-inch steel plate, to the lower side of which, at its extreme ends, are riveted the up and down take saddles which receive the end of the five-inch rear down take tubes, and at the forward end the five-inch nipples before described, which are expanded into the upper row of horizontal headers. Inside and outside hand-holes are provided opposite the ends of each tube, the former for preventing serious accident to those in charge of the boilers in case of the breakage of a hand-hole plate bolt, and the latter for providing the necessary water-tight joint.

The length of the grates under each boiler is six feet, and the width of the furnace 99 feet, and were designed for the ultimate introduction of a mechanical stoker of some improved pattern, when the next series of boilers are placed in position.

Underneath each section of grates and below the level of the boiler house floor, is a pit or tunnel as before stated, in which is a tramway for conveying the ash and clinkers collected in a car provided for that purpose, and by means of a turn-table the car is transferred to the longitudinal pit or tunnel

located at the center of the boiler house, from whence it is propelled to the street and finally hoisted by power into the cart for conveying it away.

This system of tunnels is plainly shown at Sheet No. 4.

ECONOMIZER.

At the rear of the boilers, and common to each section of two boilers, is placed vertically a Green economizer, having 192 four-inch cast iron tubes, each 10 feet long. The flues leading to the economizers are so arranged, as will be seen by referring to Sheet 4, that the gases may be diverted by dampers through the economizer or into the underneath direct flue leading to the chimney, at will.

CHIMNEY.

The chimney which is 14 feet interior diameter, and when completed will be 238 feet in height above zero level, is located midway between the two streets and about 125 feet from the river line, and is surrounded by the engine room. The foundation is composed of 405 spruce piles, as per Sheet 18, driven down from 45 to 53 feet below established high water line, and cut off five feet below this line, and upon these, encased in sheet piling, is a bed of concrete 44 feet wide by 59 feet long and 6 feet 9 inches deep, thus forming a block of 16,000 cubic feet and weighing about 2,000,000 lbs., which is composed of one part Norton's hydraulic cement, two parts sand and three parts broken stone. Upon this bedway is started the brickwork, 36 feet square.

The first five feet of the walls are laid up in the proportion of one cement to one sand; above that, and up to the 85 foot level, the proportion being one to two, and the balance of the walls laid up with lime mortar composed of four parts sand, two lime and one cement. All surfaces of the core or flue that are exposed to the heat are laid up with lime mortar. For the outside walls, as for the other buildings, red soapstone finish mortar was used, which becomes very hard after a short exposure or when dry.

The brick used was a quality especially burned for us by a local company, our only requirement being that all of them should be extremely hard and tough, without regard to color or size, and from the large quantity of brick required for the work ample good colors for the outside work are readily culled.

The chimney at the base is made up of three walls, the outer being 28 inches thick, the intermediate 12 inches and the core or flue 16 inches. The intermediate wall is octagonal in cross-section and surrounding the core or flue, which has an internal diameter of 14 feet. The outer and intermediate walls are joined together by eight buttresses, both being carried up at the same time and thus thoroughly bonded together. Eight inside buttresses also extend to within one inch of the outside of the flue wall and are carried up to its extreme height.

The cross-sections at the several elevations being represented by Sheet 17.

As the intermediate walls are carried up plumb and the 28-inch outside wall has a batter of 2.88 inches in 10 feet, they finally intersect at the 90 feet level and from that point the walls are gradually reduced to 20 inches in

thickness, thence to 16 inches, and, finally, 12 inches at the commencement of the enlargement for the cap.

At the 38 feet 2-inch level a series of granite stones are placed in each corner of the square, the same are so cut that the form of the chimney is changed to an octagonal cross-section at the 46 feet 2-inch level, and that form is thereafter maintained. From this 46 feet 2-inch level at each corner of the octagonal are pilasters 24 inches wide and projecting four inches from the surface of the wall.

The flue or core of the chimney has a 16-inch wall, as above referred to, and is reduced at the 78 feet 2-inch level to 12 inches, and again at the 163 feet 2-inch level to 8 inches, and is thus continued up to within four feet of the top.

At the bottom of the chimney means are provided by arched openings through the various walls, for access to all spaces in the base, for cleaning, etc. These passage ways in the intermediate wall by ascending vertical ladders built into the outer and intermediate walls for that purpose, also afford access to the damper bearings which are on the 37 feet 2-inch level.

The damper is made up of two sections, each hung at an angle of 30° from a horizontal line, so that by rotating each 60° the two extremes of their motion will be reached.

Each half of leaf of the damper is composed of six sections of ¾-inch cast iron plates having flanges thereon for bolting together and through which passes a 2x2-inch wrought iron spindle or shaft, the ends of which are turned down to 1¾-inch diameter which rotate on anti-friction pulleys, 3⅜-inch diameter. The levers for operating the dampers are located between the outer and intermediate walls and the connections therefrom pass downward, thence through the wall and, finally, outside of the chimney, where they are acted upon by the damper regulator.

This unusual course was provided so that all of the connections would be protected from the weather, as the dampers themselves are above the roof of the engine house.

The cap surmounting the chimney is of an octagonal form for the core as well as the outside and is made up of 16 sections bolted together with copper bolts; and the recess formed between each joint is calked two layers of ⅛-inch copper wire for the purpose of forming a water-tight joint and thus protect the underlying brick work and at the same time forming a metallic contact between the several sections of the cap and at the same time acting as a guard against lightning. To the cap proper is secured by copper bolts a cast iron cresting of plain design and of about five feet in height and which also forms part of the lightning conductor. The absolute metallic contact between all sections of the cap and cresting prompted the connection therewith of the 1½x⅛-inch copper rod which terminates at its lower end to a 16-inch cast iron water pipe running to the river, and, consequently, always submerged, leads us to believe that all possible provisions have been made for this erratic, uncontrollable alternating current.

Between the intermediate wall and the flue is built in a ladder formed of 1¼-inch round iron, one end of which being built solid into the intermediate

wall while the other end is left free to accommodate itself to the expansion of the flue. This ladder is located a short distance from the angle of the octagonal and is carried plumb the whole length of the flue.

Directly above and below the opening for the smoke flue, which is 10 feet wide and 18 feet high, is built into the outside wall and 8 inches from the outside thereof, two 1¼-inch rods, the ends of which are 1½ inches in diameter and secured to a heavy cast iron plate, above these are built in every 20 feet, 4x½-inch and 3x½-inch bar iron laid edgewise which, when bolted together, forms an octagonal of sufficient size to extend to within eight inches of each side of the chimney. The last of these bar iron braces are placed at the 153 feet, 2-inch level.

The method of construction is of a very simple nature. At the commencement a 12x12-inch cast iron plate, having thereon a center or bench mark, was placed in the center of the chimney and from that center mark the chimney is re-established every 20 feet throughout its height.

All materials used in construction were conveyed to the top by an elevator, having a platform, 4x4 feet, arranged to run up and down inside of the shaft and guided at opposite corners by 6x6-inch hard pine vertical timbers which also serve for the gripping device to act upon in case of accident to the manilla cable. As the work progresses, the upper framework carrying the overhead 30-inch sheive is hoisted up and new framework added directly below, at the same time interior scaffolds were built in every five feet and secured by 6x8-inch timbers placed in the wall.

There will be used in its construction, 1,500,000 brick.

In conclusion, we desire to place on record the fact that the development and phenomenal success of this company, which started but five years ago with 29 lights, and the inception of this new station, marking an advance in this field of engineering, is due to the broad and comprehensive labors and achievements of Marsden J. Perry, Esq., vice-president and general manager, a gentleman of sound business abilities, readily grasping engineering details and fully appreciating the axiom that the best is the cheapest in the end.

The hour for adjournment having passed, the discussion of Mr. Henthorne's paper was postponed until the afternoon session, and a motion of adjournment until 2.30 o'clock the same day, was put and carried.

SECOND DAY'S PROCEEDINGS.

Afternoon Session, August 7th, 1889.

The Convention was called to order at 2.30 o'clock P. M. by the President, who then introduced Mr. Wyman, of Boston.

Mr. Wyman read the following paper on the "Constitutionality of Electrical Execution":

CONSTITUTIONALITY OF EXECUTION BY ELECTRICITY.

ADDRESS DELIVERED BY FERDINAND A. WYMAN, ESQ., OF BOSTON, BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT NIAGARA FALLS, N. Y., AUGUST 7TH, 1889.

I have been honored by an invitation to say a few words to you upon the subject of putting criminals to death by electricity.

I maintain that, at the present time, under the existing laws, except in a few States, legislatures cannot authorize and courts cannot inflict such punishment.

The theory that "all men are born free and equal, and have certain natural, essential and unalienable rights, among which may be reckoned the right of enjoying and defending their lives and liberties, that of acquiring and protecting property,in fine, that of seeking and obtaining their safety and happiness," lies at the very foundation of the government of each State of our Union.

When a man takes from his neighbor's rights by crime, government takes from his rights by punishment. Punishment is to "reform the offender; to deter him and others from committing like offenses, and to protect society." (Bouvier's Dict., Punishment.) The criminal should suffer for his misdeeds to gain these ends of punishment, but punishment should go no further.

The people of each State decide what laws are necessary for their safety and happiness, and they have committed to writing the fundamental principles on which they desire to be governed in instruments called Constitutions. With these Constitutions all acts of legislatures must harmonize or be null and void.

Constitutions are simply articles of co-partnership, and we are all partners (some active, some silent) and are working under the partnership articles. It is frequently the case that an article is inserted "that no partner shall become surety 'upon bonds.'" Now, if at any time it becomes desirable for one partner to go upon such bond then is the time to change the articles of co-partnership (or amend the Constitution), and not go on and violate the provisions thereof. It is not as though the Constitution was like the laws of the Medes and Persians, unalterable, for the Constitution can be changed at any time through the channels provided by the instruments themselves. *Laws* are made by bodies of men chosen for brief periods, on account of their ability to cope with a general variety of subjects, and who are sworn to support and uphold the Constitution under which they are acting. *Constitutions* are made and changed by the direct voice of the people acting upon some particular subject and with a direct bearing upon the subject. We, each of us, live in our respective States because we like the Constitution of the State.

If at any time we are dissatisfied, we can, if a sufficient number of our fellow-citizens think our views are right, change the Constitution. Failing in that, and not liking to live under a rule of a majority, I do not think we have a right to complain, especially with such good walking to Canada and Mexico, and steerage passage to Europe only $12. If then, some believe in the efficacy of electricity to punish criminals, and if, as I maintain, such mode of punishment is now illegal, at least in nearly all States, such believers can try to change the Constitution under which they live, and, if unsuccessful and dissatisfied, can seek green fields and pastures new.

In the "Report of the Commission to Investigate and Report the Most Humane and Practical Method of Carrying into Effect the Sentence of Death in Capital Cases," appointed in New York, in 1886, the following list is given of the various modes of Capital Punishment: *auto da fe*, beating with clubs, beheading, decapitation, blowing from cannon, boiling, breaking on the wheel, burning, burying alive, crucifixion, decimation, dichotomy, dismemberment, drowning, exposure to wild beasts, flaying alive, flogging, knout, garrote, guillotine, hanging, *hari kari*, impalement, iron maiden, *peine forte et dure*, poisoning, pounding in mortar, precipitation, pressing to death, rack, running the gauntlet, shooting, stabbing, stoning, strangling, suffocation.

The people of nearly every State have placed limits upon the power to punish for crimes. The Eighth Amendment to the Constitution of the United States declares that cruel and unusual punishments shall not be inflicted.

There is a similar limitation in the Constitutions of the following States:

Colorado,	Constitution,	1876.
Georgia,	"	1868.
Indiana,	"	1851.
Iowa,	"	1857.
Missouri,	"	1875.
Nebraska,	"	1875.
New Jersey,	"	1844.
New York,	"	1846.
Ohio,	"	1851.
Oregon,	"	1857.
South Carolina,	"	1868.
Tennessee,	"	1870.
Virginia,	"	1870.
West Virginia,	"	1872.
Wisconsin,	"	1848.

The people of the following States in their Constitutions declare that "cruel *or* unusual punishments shall not be inflicted."

Alabama,	Constitution,	1875.
Arkansas,	"	1874.
California,	"	1849.
Florida,	"	1868.
Kansas,	"	1859.

Louisiana,	Constitution,	1868.
Maine,	"	1875.
Maryland,	"	1867.
Massachusetts,	"	1780.
Michigan,	"	1850.
Minnesota,	"	1857.
Mississippi,	"	1868.
Nevada,	"	1864.
New Hampshire,	"	1792.
North Carolina,	"	1876.
Texas,	"	1870.

"Cruel punishments" are forbidden in

Delaware,	Constitution,	1831, Art. I, Sec. 11.
Kentucky,	"	1850, Bill of Rights, Sec. 17.
Pennsylvania,	"	1873, Dec. "
Rhode Island,	"	1842, " "

The Constitution of Illinois says: "All penalties shall be proportioned to the nature of the offence." The Constitution of Vermont provides that all fines shall be proportioned to the offences. But no restriction exists in the Constitution of Connecticut. While it may be true that the legislatures of Connecticut, Illinois and Vermont, have power to punish crime with death by electrical current, no such power exists in the law making bodies of all other States, as such punishment is unusual and also cruel. For a few minutes let us look at the origin and history of such a restriction in Constitutions, then at the opinions of judges as to its purpose and meaning.

The phrase "cruel and unusual punishment" first occurs in the declaration of rights presented by the convention to William and Mary, before settling the throne upon them, in 1689.

"On February 13, 1689," in the words of Corbett's Parliamentary History, Vol. 5, p. 108, "This day, about ten of the clock, Mr. Speaker, attended with the mace, and the house of commons following him in a body, went in their coaches to Whitehall, where the right hon., the marquis of Halifax, Speaker of the house of lords, with the house of lords, being placed on the right side of the door, within the Banqueting house, and the right hon. Henry Powle, esq., Speaker of the house of commons, with the commons on the left side of the door of the said Banqueting House, waited the coming of the Prince and Princess of Orange, who, immediately after entering in at the upper end of the Banqueting House, came and stood upon the step under the canopy of state, where being, the Speakers of both Houses, together with the lords and commons that accompanied them, were brought up by the gentleman usher of the black rod, making three obeisances, one at the lower end of the room, one in the middle, and one at the step where their highnesses stood. And then the Speaker of the house of lords acquainted their highnesses that both houses had agreed upon a Declaration to be presented to their highnesses which he desired might be read, which being granted by their

highnesses, the Clerk of the house of lords, by order of that house, read the Declaration as followeth :—

"*Whereas*, the late king James II, by the assistance of divers evil counsellors, judges and ministers employed by him, did endeavor to subvert and extirpate the Prostestant religion and the laws and liberties of this kingdom. * * And, *Whereas*, of late years, partial, corrupt and unqualified persons have been returned on juries on trials, and particularly divers juries in trials for high treason, which were not freeholders, and excessive bail hath been required of persons committed in criminal cases, to elude the benefit of the laws made for the liberty of the subjects ; and excessive fines have been imposed and illegal and cruel punishments inflicted. * * *

"And, *Whereas*, the said late King James II, having abdicated the government and the throne being thereby vacant. * * * And thereupon the lords, spiritual and temporal, and commons, pursuant to their several letters and elections, being now assembled in a full and free representative of this nation, taking into their most serious consideration the best means for attaining the ends aforesaid, do in the first place (as their ancestors in like case have usually done) for vindicating and asserting their ancient rights and liberties declare : * * * That excessive bail ought not to be required, nor excessive fines imposed, nor cruel and unusual punishments inflicted."

The proceedings in Congress on the amendment were as follows :

On Monday, August 17, 1789, the House as a Committee on the Whole on the State of the Union, in considering in order the amendments to the Constitution proposed by Mr. Madison, took up the amendment now numbered VIII, "excessive bail, etc.," then sixth clause, fourth proposition.

According to the Annals of Congress, which were the "debates and proceedings in the Congress of the United States," compiled from authentic materials, by Joseph Gales, Sr., on page 754 :

"Mr. Smith, of South Carolina, objected to the words 'nor cruel and unusual punishments,' the import of them being too indefinite.

"Mr. Livermore : The clause seems to express a great deal of humanity, on which account I have no objection to it but it seems to have no meaning to it ; I do not think it necessary. What is meant by the term excessive bail? Who are to be the judges? What is understood by excessive fines? It lies with the court to determine. No cruel and unusual punishment is to be inflicted ; it is sometimes necessary to hang a man, villains often deserve whipping and perhaps having their ears cut off ; but are we, in future, to be prevented from inflicting these punishments because they are cruel? If a more lenient mode of correcting vice and deterring others from the commission of it could be invented, it would be very prudent in the Legislature to adopt it, but until we have some security that this will be done, we ought not to be restrained from making necessary laws by any declaration of this kind.

"The question was put on the clause, and it was agreed to by a considerable majority."

On Thursday, August 21, 1789, on the report of the Committee of the Whole, this clause was adopted :

The Courts have spoken as follows upon the meaning of this phrase cruel and, or, cruel or unusual punishments.

In New Mexico the Court said: "All punishment is more or less cruel, and the kind of punishment to be inflicted upon criminals to induce reformation, and repress and deter the thief from a repetition of his larcenies, has generally been left to the sound discretion of the law-making power. * * * The word cruel, as used in the Amendatory Article of the Constitution, was no doubt intended to prohibit a resort to the process of torture resorted to so many centuries as a means of extorting confessions from suspected criminals, under the sanction of the civil law. It was never designed to abridge or limit the selection by the law-making power of such kind of punishment as was deemed most effective in the punishment and suppression of crime."

Garcia *v.* Territory, 1 Mexico, 417.

Our United States Supreme Court said: "Difficulty would attend the effort to define with exactness the extent of the Constitutional provision, which provides that cruel and unusual punishments shall not be inflicted, but it is very safe to affirm that punishment of torture, such as there mentioned by the commentator, referred to (Blackstone), and all others in the same line of unnecessary cruelty, are forbidden by that Amendment to the Constitution."

Wilkerson *v.* Utah, 99 U. S., 135.

A Judge of the Supreme Court of New York, said: "It is difficult by a general definition so to define the phrase 'cruel and unusual punishments' as to cover its entire meaning, and that which in the judgment of one man is cruel, may not seem to be so to another, and that which is unusual to the sight of one individual is quite usual to that of another. * * * Acts are startling only by comparison. The punishments inflicted by barbarous nations are neither cruel or unusual when measured by their standards, and they become so only when measured by the more humane one of civilization, nay, in some of the States of our Union there have been and now are statutes prescribing punishments, which the almost universal judgment of our Commonwealth would pronounce 'cruel and unusual,' and yet such statutes have there been upheld. * * * Evidently then the law of the State of New York, prescribing punishments for crimes committed within a certain locality must be judged by its own general standard. Its right to change such general standard is unquestioned." And the Judge maintains that the prohibition extends to the *degree* of punishment, as well as to the kind.

"If, then," he adds, "it may be asked, is it just to pronounce any punishment 'cruel and unusual' because not of a *kind* to which we have been accustomed, and therefore shocking to our moral sense, why is the same rule unsound when the *extent* thereof is to be judged?"

Matter of Bayard, 61, How. Pr., 300.

In this case of Bayard, a man who had been convicted of petit larceny in Cohoes, and was sentenced to imprisonment for one year, which was greater than the punishment for a similar offence elsewhere in the State, was discharged by a single Judge of the Supreme Court, but this decision was

reversed by the General Term. In pronouncing the decision in the latter case, 63 Howard Pr., Rep. 76, the Court says that declaration (Bill of Rights, 1689) recites crimes and errors which had made the Revolution necessary.

"These recitals consist of the acts only of the former King and the judges appointed by him, and one of them was that illegal and cruel punishment had been inflicted.

"The punishments complained of were the pillories, slittings and mutilations, which corrupt judges of King James had inflicted without warrant of law, and the declaration was aimed at the acts of the executive, for the judges appointed by him and removable at pleasure, were practically part of the executive.

"It clearly did not then refer to the degree of punishment, for the criminal law of England was at that time disgraced by the infliction of the very gravest punishment for slight offences, even petit larceny being then punishable with death.

"But the declaration was intended to forbid the imposition of punishment of a kind not known to the law, or not warranted by the law.

"The courts have rarely had occasion to construe the meaning of the phrase 'cruel and unusual punishment.' * * * The text writers * * * seem to understand it as prohibiting any cruel and degrading punishment not known to the common law, and probably also those degrading punishments which in any State had become obsolete when its existing Constitution was adopted, and punishments so disproportioned to the offence as to shock the sense of the community." * * *

In Done *v.* The People, 5 Parker, New York, 382, Campbell J. enumerates the various punishments in England and New York, and adds: "I have run over this brief outline history of the punishment of death for crimes anterior to the Revolution, for the purpose of showing that there was a cause for the declarations in the Bill of Rights, and also as it tends to shed light on the subsequent legislation in relation to capital punishment in our State. It will be seen that under that legislation the punishment of death must be inflicted by hanging, and that burning at the stake, quartering and disemboweling, breaking in the wheel and gibbeting alive, would no longer be allowed, whether the power to do so was derived from colonial acts, from the common law, or whether the condemned parties were Indians, negroes or white men. Our Bill of Rights had declared that neither unusual nor cruel punishments should be inflicted. Burning at the stake, if it had not been an unusual, was a cruel punishment; so was breaking in the wheel, and so was gibbeting alive. All these punishments had been inflicted while New York was an English province."

In Alabama, Turnipseed *v.* Alabama, 6 Ala., 664, where a statute prohibited the infliction of any "cruel or unusual punishment" on a slave, and an indictment charged a man with inflicting "cruel and unusual punishment," the Court said: "True, the statute makes two offences, or rather does not require that the punishment inflicted upon a slave shall be both *cruel* and *unusual* to subject the offender to its exactions; it is enough if the proof

shows it to be either the one or the other. To punish cruelly is one, and unusually is another, breach of criminal law. The statute, it is apprehended, does not use the epithets as synonymous, nor in contrast with each other; but it was merely intended to make the enactment sufficiently broad to embrace a high offence against good morals, no matter under what circumstances committed. *Cruel*, as indicating the infliction of pain of either mind or body, is a word of extensive application; yet every cruel punishment is not, perhaps, unusual; nor, perhaps, can it be assumed that every uncommon infliction is cruel. But, be this as it may, there may be punishment that is both cruel and unusual.

The following punishments have been held to be not within the prohibition of the Constitutions. In New York and Pennsylvania, disfranchisement and forfeiture of citizenship.

Huber *v.* Reilly, 3 Smith, Pa., 112.
Barker *v.* People, 3 Cowen, 686.

In Missouri, labor on the public streets.

Ex parte Bedell, 5 Western Reporter, 111.

In Vermont, cumulative punishment.

State *v.* O'Neil, 1 New Eng., Rep., 775.

In Tennessee and Massachusetts, fine and imprisonment.

Ligan *v.* State, 3 Heisk, 159.
Commonwealth *v.* Hitchings, 5 Gray, 486.
Pervear *v.* Commonwealth, 5 Wall, 475.

Under Federal Law, death by shooting.

Wilkerson *v.* Utah, 99 U. S., 135.

In the above case of Commonwealth *v.* Hitchings, the Court says: "A law subjecting a person making a single unlawful sale of intoxicating liquor, for a first offence to the payment of a fine of ten dollars and costs of prosecution and imprisonment in the House of Correction, not less than twenty nor more than thirty days is not within the prohibition."

In Georgia, imprisonment of one convicted of assault with intent to kill, for ten years in the Georgia Penitentiary, is not cruel and unusual punishment, because he is afflicted with epilepsy.

Fogarty *v.* State, 5 South East, Rep., 782.

In Kentucky, a fine of one cent and imprisonment for three years in a county jail for an assault with a cane and a cowhide, is held not to have been cruel punishment.

Cornelius *v.* Commonwealth, 84 Ky., 583.

In Texas, imprisonment for five years in a penitentiary for stealing a horse, the term to begin on the expiration of an equal term for stealing another horse, is not a cruel or unusual punishment.

Lilliard *v.* State, 17 Texas, Appeals, 14.

A fine of $50 and imprisonment at hard labor in the House of Correction for three months for keeping and selling intoxicating liquors, is not cruel or unusual.

Pervear *v.* Commonwealth of Mass., 5 Wall, 475.

In Virginia, the Court said: "The common law undoubtedly considered corporal chastisement by the infliction of blows on the bare back as one of the ordinary modes of punishment, and such punishment has been held not to be within the prohibition of our State Constitution, against cruel and unusual punishments."

• Commonwealth *v.* Wyatt, 6 Randolph, 694.

In Tennessee, the Court said: "Our sturdy ancestors not only allowed it in the case of criminals, sailors and soldiers, but considered it a proper discipline for their wives and children."

Cornell *v.* State, 6 Lea, 629.

So that in Virginia and Tennessee, "corporal punshmenti by the infliction of blows on the bare back" is allowed.

Aldrich *v.* Com., 2 Va., Cas., 447.

Under Federal Law flogging was permitted in 1835,

U. S. *v.* Collins, 2 Curt., 194,

but prohibited in 1850. U. S. Rev. Stat., 4611.

In Maryland and New Mexico, whipping was allowed.

Foote *v.* State, 59 Md., 266.

Garcia *v.* Territory, 1 New Mex., 417.

Thus far we have enumerated only those decisions which have decided certain punishments to be legal, or the judge exercised his discretion permitted by statute. The courts hold such punishments to be unconstitutional and void only in clear cases of conflict with the fundamental law of the Constitution. We will now examine the cases where punishments have been held to be illegal because cruel and unusual.

In State *v.* Giles Driver, 78 North Carolina, 423, a husband while in a passion and under the influence of drink, whipped his wife with a switch, and with such severity as to leave the marks for two or three weeks, and kicked her once. He had whipped her before, but not with the same severity, and when brought to trial for the last whipping, pleaded guilty. The judge sentenced him to imprisonment in the county jail for the space of five years, and at the expiration thereof to give security to keep the peace for five years in the sum of $500, with sureties. He was unable, from poverty, to appeal, but afterwards brought the case up for review by *certiorari* on the ground that such sentence violated the State Constitution which forbids "cruel and unusual punishments." The Court, in its opinion, refer to the case of State *v.* Miller, 75 North Carolina, where a man was sentenced to imprisonment in the county jail and where the Court awarded a new trial on certain grounds, strongly intimated that the sentence was unconstitutional. The Court said: "In our case his Honor imprisoned the defendant for five years, not in the penitentiary where he may live so long, but in the county jail where it is strongly probable that confinement and fetid air would cause a lingering death. The oldest member of this Court does not remember an instance of five years' imprisonment in a county jail for any offence." In

this case of State *v.* Driver, the Court held the punishment to be not only "unusual" but unheard of, and also to be "cruel."

In Ho Ah Kow *v.* Mathew Nunan, 5 Sawyer, 552, an ordinance directed against the Chinese, ordering persons imprisoned for a certain misdemeanor to have the hair of his head "cut or clipped to a uniform length of one inch from the scalp thereof," was held to be illegal. Mr. Justice Field says: "The ordinance was intended only for the Chinese in San Francisco. This was avowed by the supervisors on its passage, and was so understood by everyone. The ordinance is known in the community as the 'queue ordinance,' being so designated from its purpose to reach the queue of the Chinese, and it is not enforced against any other persons. The reason advanced for its adoption and now urged for its continuance is that only the dread of the loss of his queue will induce a Chinaman to pay his fine. That is to say, in order to enforce the payment of a fine imposed upon him, it is necessary that torture should be superadded to imprisonment. * * * Probably the bastinado, or the knout, or the thumb-screw, or the rack would accomplish the same end; and no doubt the Chinaman would prefer either of these modes of torture to that which entails upon him disgrace among his countrymen, and carries with it the constant dread of misfortune and suffering after death. * * * The complaint in this case shows that the ordinance acts with special severity upon Chinese prisoners, inflicting upon them suffering altogether disproportionate to what would be endured by other prisoners if enforced against them. Upon Chinese prisoners enforcement acts as a 'cruel and unusual punishment.'"

That the infliction of death by the electrical current is illegal in those 16 States whose Constitutions forbid "cruel *or* unusual punishment," can hardly be doubted, for although under certain circumstances courts construe "or" to mean "and," and "and" to mean "or," yet this is true only where the whole language plainly requires such construction. No one can honestly deny that the punishment of criminals by death from electricity is not only unusual but unprecedented. It is idle to say that the punishment is death and such punishment is usual. Such argument would prove the uselessness of any constitutional provision for a sentence to death by burning, by gibbeting, by the rack, by any horrible torture, would be authorized, as it would merely sentence to death, and punishment by death is usual and not cruel! The *means* by which the punishment is inflicted are clearly within the limits of the restrictions.

Such punishment is unusual, but is it cruel? I maintain that the attempt to put to death by electricity is cruel. Think of the agony experienced by the prisioner on being put into the rack (for it is no more or less than a rack) upon which he is to be killed at some time, perhaps ten minutes, perhaps an hour. The man does not live who can tell how much electricity it takes to kill a human being. I have personally, within ten days, conversed with a man who took a full 2,500 volt shock and he is alive and well. He was unconscious for some time after receiving the shock, but during the interval between the shock and the unconsciousness, he realized that he had been

struck by some terrible force. A man may have heart disease and be easily frightened to death by the sudden opening of the door, still you would not undertake to punish criminals by scaring them to death by opening doors. You may be able to frighten a man to death by means of the rack now proposed without even connecting the paraphernalia with a dynamo. We all remember the well authenticated case of the man who having been sentenced to death for crime, consented to be put to death by being blindfolded and having an artery in his arm opened; then, when the surgeon scratched his skin only and did not draw a drop of blood, but let warm water strike his arm and fall drop by drop so the criminal could hear it; the criminal slowly lost strength and, finally, died by that treatment.

In the examinations that have been held before a referee, in New York, to determine whether the punishment of death by the electrical current, to which Kemmler has been sentenced, is unconstitutional, because "cruel and unusual," many experts having testified that no means existed by which to tell whether any amount of electricity would certainly kill every man, so greatly differed powers of resistance; men who have been struck by lightning have related their experiences, showing that even the immense power of Nature's battery has sometimes failed to kill; men who have received shocks from wires charged with currents of varying force, have told of their sensations and the horrible pain they suffered. When the State brings forward men who testify to their belief that death by the electrical current is certain and painless, there arises a conflict of evidence. When experts disagree, who shall decide? In the testimony before the referee, and in the articles and discussions in newspapers and magazines, the preponderance of evidence has been that such punishment is cruel, or at least enough evidence of its cruelty has been given to raise a reasonable doubt in the mind of an ordinary man; enough surely to prevent humane and enlightened legislators in other States from adopting such means of punishment in the present age of uncertain knowledge of electricity, and enough to induce the legislators of New York to repeal their own law requiring such mode of punishment.

But the question now before us is whether the courts of New York will pronounce such punishment unconstitutional because "cruel and unusual," and not whether the law-making body of New York would, with all the evidence then before it which now exists, have refused to legalize such a cruel and unusual punishment. To enable the courts to declare that a statute is unconstitutional, its invalidity must be shown beyond a reasonable doubt. As the Supreme Court of Massachusetts said, in Talbot *v.* Hudson, 16 Gray, 422. "But it must be borne in mind, that in determining the question whether a statute is within the legitimate sphere of legislative action, it is the duty of courts to make all reasonable presumptions in favor of its validity. It is not to be supposed that the law-making power has transcended its authority, or committed under form of law a violation of individual rights. When an act has been passed with all the requisites necessary to give it the force of a binding statute, it must be regarded as valid, unless it can be clearly shown to be in conflict with the Constitution. It is, therefore,

encumbent on those who deny the validity of a statute, to show that it is a plain and palpable violation of constitutional right. It they fail to do so, or leave room for a reasonable doubt upon the question whether it is an infringement of any of the guarantees secured by the Constitution, the presumption in favor of the validity of the act must stand."

See also State *v.* Lasater, 9 Bax., 587.

In the case of Kemmler there is, as I have before said, either a preponderance of evidence that punishment by the electrical current is cruel and unusual, or, at least, a reasonable doubt exists as to its non-cruelty; and in my opinion it can be said with truth that it has been proved *beyond a reasonable doubt* that it is cruel.

I have tried to show that the power to punish lies in the law-making bodies except so far as they are restrained by constitutional provisions; that cruel punishments are forbidden in some States, "cruel and unusual" in others, and "cruel or unusual" in others; to the history of such a restriction has been added the words of judges in construing it. My endeavor has been to show that punishment of death by means of the electrical current is so cruel that legislators ought not to adopt it, so cruel that the legislators of New York ought to repeal their law, and so cruel that the courts of New York ought to pronounce the statute unconstitutional.

THE PRESIDENT: We will now hear from Dr. Moses.

DR. MOSES: Mr. President and gentlemen of the Association: We all have a very deep interest in the subject which has been just broached by Mr. Wyman, of Boston. I did not have the pleasure of listening to all of his paper, but I think in one or two sentences he laid very clearly before us what his belief and his proof was that killing by electricity is a cruel and an unusual punishment, and, therefore, violating all the Constitutions of the different States of this country. That is a view that I think will prevail ultimately, and lead, as we hope, to a repeal of this very obnoxious law that is now agitating our press and our people. That law it would be well for us just now to consider in its history, and then I will offer a few remarks upon statistical information which I have gathered, owing to the kindness of the various members of this Association and of others even not connected with it, and then we will proceed to show that the main object of the law is violated in the act of carrying it out. That is to say, the object of the law was a philanthropic one. The method by which the killing is to be conducted is one of the most barbarous that could possibly be devised, and, therefore altogether unnecessary.

Two years ago, many of us, I among the number, received from Mr. Elbridge T. Gerry, the noted philanthropist, of New York, a communication, in which he requested some opinions or expression of views on a proposed law of killing by electricity. But I happened to be away, and though he once or twice wrote to me after that, I never received his letters, and, consequently, did not participate in the deliberations which led him finally to recommend to the Legislature of the State of New York that hanging should be abolished and killing by electricity should be substituted for it. The law was put upon the statute books, but very soon it became apparent, however, that it was a hasty proceeding; we, meeting at our several conventions, were too much occupied with the useful and the practical side of our art and science to engage in any considerations of such a far-fetched use of electricity as killing. The result was that we allowed the law to go almost unnoticed upon the statute books, and, finally, when the time came for a criminal to be condemned, we were ourselves placed in that awkward position of representing an interest, the chief instrument of which was to become a public executioner. It seemed as if by an instant revulsion of feeling we became conscious of the fact that some one or some interest had been at work for the purpose of bringing opprobrium upon electricity. That was considered far-fetched in the beginning, but afterwards, when we saw the precise methods, the cruel calculation, the persistence of certain individuals—I might say one individual—constantly bringing before the public the fact that the law had to be executed and then, finally, trying to concentrate it in such a way as to bring a further opprobrium of deeper dye, as it were, upon one branch of our beloved art and science—when we saw that, we were aroused. The result was, that by a sort of spontaniety of action, protests were sent forward. The first criminal who was condemned to death under the law was not killed, but an effort was made to prevent his death and he is to-day in that most unfortunate position. Only recently, at Buffalo, the matter has been argued after a prolonged hearing before a referee in New York, and a most enormous amount of testimony of a very conflicting nature has been brought to bear. It is a sad thing that we have conflicting testimony, because the fact that certain experts gave their opinions *pro* and *con*, has

been taken by the press to convey the idea that an uncertainty has existed in the minds of those who use the current in great quantity, as to its killing effects.

Now, this action in New York and in Buffalo has led to a simultaneous effort on our part to bring this matter before the Convention for deliberation. In order to have information for the Convention, a letter was addressed to every manager of a central station in the United States, to the number of over 800, requesting him to give information on certain very important points.

If, now, electricity was to be used as a killing agent, it should be a certain agent. I will not go into the question of its mercifulness, because from the collaterals which I will present later you will see that instead of being a merciful agent it is the most cruel and dreadful agent imaginable, and for that reason alone the law should be repealed. But aside from that, its uncertainty is the element that ought at once to condemn it as the means of public execution. I received from these 800 circulars which we sent to the different companies, several hundred answers. They have been closely scanned and some of them were directed to us up here. I have, for the last two nights, as closely as possible, analyzed their contents, and I have come to certain conclusions, which I will state to you briefly.

As some statistics of these I may say that I have receiver, deplies in which I estimate that there were 73 accidents that had happened in central stations. Of this 73, 19 were due to the alternating current, the balance to the continuous current. The questions that we asked bring out some very remarkable information, and I have from this numerous list of answers collated some here, which are open to members of the Convention. I will read some of the remarks which show that the sensation produced by heavy currents not sufficient to cause death, is so dreadful and so various that I think I can safely say that an examination of these papers will not be able to controvert it, that no two people agree as to the exact symptoms; that is, they had not the same sensation. For instance, it is clear that the action of the current upon one man was like cutting him in two with a buzz saw; another one says it was like striking him on the back of the neck with a sledge hammer; another like knocking his brains

out with a trip-hammer; another said that he felt himself full of needles; another, as if he had fallen from an immense height and had been dashed to pieces upon the ground; another, as if he had been smashed. So that altogether you will see that the symptoms are different in all individuals, and all accompanied with the most dreadful sensations.

Now, if this law has been passed, it brings an obloquy upon our profession. If that law is to be enforced, we will be bringing to bear upon the prisoner a punishment greater than any devised during the time of the Spanish Inquisition. There they had numerous punishments, but there was nothing that simultaneously tortured every nerve of the body. They would put them upon the rack; they would draw you apart, limb from limb; they would put you on the horse; they would tie you by the thumbs; they would pluck out your eyes. But they never took every nerve in your body and put it upon the stretch in one instant. I look upon the execution by electricity as one of the most dreadful concoctions of a barbarous mind.

Now, gentlemen, an effort has been made, and a persistent one, to bring this about. I have looked around in many directions for a case of this kind, and when I see that every citizen of New York and all of our large cities, to-day, fears to touch a wire; that they pass hastily under an arc light wire that is stretched across the street; that they shun it; that they feel, as I have been told, that when they are introducing an electric wire into a house they are in contact with the same instrument that is to deal death upon a criminal; when they feel in that way, I say that such feelings will result disastrously to our interests.

We should, with all the energy that we have, push forward and try to prevent this. Those who are inimical to us spread such reports and make such efforts as to bring our electric current into disrepute. As warnings have been disregarded in the past, but in the last few weeks since the newspapers of New York have been speaking so much of execution by electricity, I have taken occasion to inquire as to the public feeling, so I may say, the private feeling. Not that that comes into the newspapers, but I begin to see that there is a certain fear being attached to the idea of an electric current. That is something that we must avoid, if possible. Let us not have electricity served as a public

executioner. Let us go before the Governor of this State, where the law exists, and ask him to repeal that law. We are the sufferers, and must influence the Executive Committee of this Convention to take some cognizance of this thing before it is carried to an execution.

There is still another thing that I would say: I do not see in this hall the face of one man who would venture to apply such a thing as an electric current for purposes of death. We are here for the purpose of advancing the uses of electricity. to make it rejuvenate the world, to carry it forward as a civilizing agent, not as an instrument of torture. I doubt whether there is in this broad country one reputable engineer—electrical engineer—who would deign to connect his name with the application of this death-dealing instrument to the purposes of public execution. When Mr. Elbridge T. Gerry, in his pamphlet, said that he had consulted physicians for the purpose of finding out whether prussic acid or morphine or strychnia or chloroform, might not be used, and he met with the universal reply that not one physician could be found to administer any of these death-dealing agents. Shall we be placed in the position that one electrician can be found willing to administer our current for the death-dealing purpose? I deny that such a thing should be and yet we hear that at this moment, while we are here in Convention, there is one at the Penitentiary in Auburn, who is experimenting on animals, preparatory to the administering of that current to that criminal, Kemmler.

I say, let us here condemn that action. It is impossible for any one, by experiment upon animals, to be able to say that what has been done with them can be done with equal effect on human beings. Let it not be trumpeted over this country that the dying groans of that criminal cursed electricity with its last sound. Let us not allow it to be said by the papers that we have been introducing that which has become a public executioner.

This thing is not a new thing—this effort to introduce electricity for the killing of human beings. It was thought of from the very day of the discovery of the Leyden jar. The first man who discovered the Leyden jar, did so by means of a violent shock, so violent that at the time he said he would not repeat it

for the crown of France. It was very soon thought after that that electricity could be used for killing criminals, and so philanthropic a man as Benjamin Franklin—in this respect, the equal of Mr. Gerry—so philanthropic a man tried experiments upon animals, in order, finally, to be able to apply it to the killing of human beings. But he had a most unfortunate experience. Benjamin Franklin killed turkeys and fowls and dogs, and on one occasion he had killed a turkey, and, in the excitement of the moment, he accidentally touched the conductors of the machine and received a shock himself, which he described as something terrible, and when I repeat the circumstances, you will see that my statement that the pain attending the administration of electricity must be something most horrible, is corroborated by this. Benjamin Franklin was looking at his hand at the instant that he felt, as he described it, throughout his whole body, a universal blow. He was, in fact, knocked senseless, recovered, was in great pain throughout his whole body, and he was told that he had been struck by the current. He was told, also, that the spot he was looking at was where the current had entered his body. He examined his hand and found upon it, as corroborative of the statement, a puncture and an elevation (as he describes it) the size of half a pistol bullet. He did not hear the sound of the discharge of the Leyden jars by which he was struck, although by some it was declared that it was as loud as the sound of a pistol, and though he had been struck by the spark which others had seen and which others had heard, he was neither conscious of it by sight nor hearing, while he felt throughout his whole system a universal blow.

Now, gentlemen, I think it will be impossible for us to determine what the amount of pain is that attends an execution by electricity. Those who have come back to us from the borderland that separated them from the eternal life, have said that they have felt the tortures of the damned. And yet they recovered within a very short time, sometimes within hours or days. Now, what must be the agony that would cause death? There is not one going to come back from that bourne from whence no traveler returns, to tell us of his sensations. Let us judge by what we know. If an explorer should go into a distant land and on his way should meet with such obstacles and dangers as to

deter others, would we not be safe in surmising that greater dangers were beyond? Such is the case here. We find, as a general experience of all those who have suffered from electric shocks of great intensity, that the pain is most intense. Therefore, why should we not expect that the execution of an individual would be accompanied by still greater pain. The object of the philanthropist is to put him out of the world without pain. I have my doubts as to whether that is desirable, but if they once state their position clearly, that their object is a philanthropic one, we can only discuss the question on that platform. I think, in passing, I would say that pain should, to a certain extent, accompany punishment. We pass through life, and when we approach the final day we find ourselves racked with pain. Nature provides that we should come in and go out of the world in pain, and why should these gentlemen, the philanthropists, say we must go out of it after having committed such crime as deserves death—why shall we go out of it painlessly? I think that is a most mistaken philanthropy. There must be a certain punishment attached to crime, which will deter others from engaging in the same crime. But that is neither here nor there.

We have, in this case, upon our statute books a law which is a most obnoxious one. Fortunately for us, a man of talent in New York has, in a disinterested way, engaged himself earnestly as the champion for us, in order to bring about the delay of that punishment, to stem the tide, in order that the legislators may think once more and then, perhaps, repeal this law. I think to Mr. Bourke Cochran, of New York, we owe, gentlemen, a certain consideration, and he deserves our praise for the manly way in which he has opposed some of the most brilliant names connected with electrical science—how he has manfully struggled to defend our interests from this obloquy. I would say, gentlemen, that now is the time for us to call to the attention of the authorities the iniquity of this law: first, as being a barbarous practice; second, as interfering seriously with a rising industry that some day or other is bound to be first in this world. And, now, let us not nip it in the bud; let us not check this growth which has been so fair financially, and for that reason I would offer a resolution which embodies the views I had thought of, and which has been put in form by those who have been con-

sidering the legislation of the country in connection with electricity. This resolution I will read:

Whereas, The law requiring the execution of criminals by electricity, enacted by the General Assembly of the State of New York, was enacted under a misapphrension of its philanthropic importance; and

Whereas, The National Electric Light Association regards such a law as an unnecessary degradation of the most useful natural agent that science has ever rendered available for the service of man; be it

Resolved, First, that the National Electric Light Association does hereby respectfully petition the Legislature of the State of New York to repeal said law at its next session. Second, that in view of the inexpediency of said law, and until it is repealed, the Governor of the State of New York be requested to commute the sentences of all criminals condemned to be executed by electricity, to imprisonment for life. Third, that a copy of this preamble and resolution be forwarded at once by the secretary of the Association to the Governor of the State of New York. Fourth, that the proper officers of this Association, and that the Chairman of the Committee on State and Municipal Legislation, forward a copy to each member of the General Assembly of the State of New York at its next session, together with copies of such papers as the committee may have at its disposal, urging the repeal of said law. (Loud applause.)

(Mr. Wyman, of Boston, handed Dr. Moses a bouquet.)

THE PRESIDENT: Gentlemen, you have heard the resolution, what disposition do you make of it?

MR. POPE: I move its adoption, Mr. Chairman.

MR. C. R. HUNTLEY (of Buffalo, N. Y.): There is in our midst a gentleman who, by the papers this morning, has been assigned as assistant to Harold P. Brown—Dr. Fell, of Buffalo. I move that he be permitted to have something to say in this Convention regarding this matter.

THE PRESIDENT: We have a very large budget to go through here, but I will say that we would like every one who has anything to say upon this topic to be as short as possible, and I hope no one will feel offended if I call them to time at the end of ten minutes. We will now leave the topic presented by Mr. Wyman and Dr. Moses open to the Convention for general discussion, and will be very glad to hear from the gentleman named by Mr. Huntley.

MR. DUNCAN: I second that motion of Mr. Huntley.

THE PRESIDENT: It is not necessary to put the motion; we

will confer the privilege of the floor to the gentleman. (Applause.)

Dr. G. E. Fell (of Buffalo): Mr. President, I came to this Convention to listen to the address upon the subject of electrical execution. I expected I would find considerable opposition to it on the part of you gentlemen engaged in the noble work you are doing in advancing human kind by this wonderful and valuable agent. I am only a physician. I am not interested in any electric light company, not interested in any way, except probably as a scientific man, in the advancement of everything pertaining to the welfare of man. I was called to make some experiments at Buffalo with this powerful agent, with the view to deciding, when the question should come up, what was the best and speediest and most humane agent we could use in the execution of criminals. Now, gentlemen, cannot we advance in this line as well as in others? From the demonstrations which I made, I could not help but come to the conclusion that there was no agent we had at our command which would execute criminals with such rapidity and without question of pain. I am satisfied that the experiments, so far as I am concerned, demonstrated that what could be done upon the lower animals could be done upon man. The question is, do we want to have the horrors of hanging kept up? We see it in newspaper reports all over the country every day. I feel that the use of electricity for the execution of criminals is not going to have the effect which you gentlemen think it will have. I do not see how the use of this great agent as the instrument of execution, could affect the welfare of mankind, and their progress in their inventions. I think that we will do away with the horror attending execution; that the use of electricity will do away at once with this horrible condition of affairs. The accidental executions which have been taking place all over the land for some time, demonstrate the question of its success. I may not look at it from the same point of view that you do. I wish I could. If I thought for one instant that the use of electricity in the execution of criminals would retard electrical progress, I would say, do not use it, but I say, if it is an advance, then let us use it and do not try and stop us from using it. I will not say anything more, as I have not the time.

Mr. Pope: Mr. Chairman, I would like to ask the gentleman one or two questions. Dr. Fell, in the use of prussic acid, is there any method known to science that will kill a man as quickly as prussic acid?

Dr. Fell: I think there is probably nothing but electricity.

Mr. Pope: Does it require the use of a harness, the adjustment of apparatus; does it require any preparations?

Dr. Fell: As to that, I do not think that electricity requires that.

Mr. Pope: It does. It requires a very careful preparation. Another thing: Did not the Medico-Legal Society resolve that the use of any method in their practice would affect their interests?

Dr. Fell: As to that question, I would say that is merely the opinion of a body of men. Whether it would or would not, I cannot say. If it would, I should say do not use it.

Mr. Morrison: Who do you think would be the best judges of the effect it would have upon the physicians' practice, that body of men, or some other body of men who did not use or knew nothing about it? The physicians gathered together and decided, as Mr. Pope suggested, that the use of any method in their practice as a means of execution, would be detrimental to them. I ask you what body of men would be best qualified to judge as to what would be injurious to the practice of their profession as physicians?

Dr. Fell: The physicians.

Mr. Duncan: When you answered the first question I addressed to you, you said probably. What do you mean to convey by that word probably?

Dr. Fell: I am only basing my statements upon my own observations, and I believe from those observations that execution by electricity can be made instantaneously, and that there will be no sensation.

Mr. Duncan: That is your belief. Now, will you give us the facts on which that is based?

Dr. Fell: That is corroborated by the numberless executions accidentally taking place throughout the country already.

Mr. Duncan: What do you mean by numberless?

Dr. Fell: Several hundred, probably.

MR. DUNCAN: "Probably," there is the same expression again. We are dealing with facts here.

DR. FELL: I seem to be in a minority.

MR. DUNCAN: If you rest your case upon that fact, I am perfectly willing to leave it.

MR. POPE: I would like to ask the gentleman, in reference to gas—which has killed more people, gas or electricity? Is it not a fact that a week or two ago a new method for the destruction of animals was introduced in the City of New York, and that that was publicly mentioned in the papers as a more humane method of despatching dogs than the method heretofore prevailing—that is, the introduction of gas in a sealed box, whereby they receive a painless death?

DR. FELL: I can answer that, Mr. President, very readily. Possibly, the use of gas or any means of that kind to produce death is painful during the first inhalations—very painful, indeed, until a man is asphyxiated—until asphyxiation takes place; and that gas would be more painful than electricity on account of the nerve current being so much less rapid than the current of electricity.

MR. WYMAN: Mr. President, I would like to say two or three words, as a man. I had to talk as a lawyer before. Now to get down to business, I want to say to you gentlemen, members of The National Electric Light Association, that if you have got a particle of spunk in you it is time to bring it right out, but if you want to go down and have your whole society and profession—I call it a profession—killed financially, then you want to allow this execution to take place. I tell you, you are scaring all the men, women and children in the United States by allowing this to go on. You are fixing it so that my wife does not dare to have it come into the house. I got her, after about ten or twelve years, so she would allow a telephone to be put in, but you are fixing it so that I cannot have an electric light. These men come in for the purpose of striking at one part of your trade—you have got to stop that. I tell every manager of an electric light station here, every manager in the United States of America, who wants to increase the income from his station, that the time for him to put his force at work is now, and to try and stop this man from being killed. You cannot do it by pass-

ing resolutions ; you can only do it by personal appeals to your Governor, which you must make, if the courts decide that the law is constitutional—I do not believe they will—then it is for you to go before the Governor, not with resolutions, but send him carloads of delegates, go yourself, say : "Here, this strikes our pockets ; it is the case of gas against electricity ; it is the case of one man with one kind of a current against another man with another kind of a current ;" and I say to you, right now, be men. Do not fool around with this any longer, but go there by carloads and lay right down on your Governor so that he has got to commute that man's sentence.

MR. ALEXANDER : Mr. President, the doctor from Buffalo stated that so and so many executions had taken place throughout the United States, or probably meant that so many people were killed by the electric current. Before a committee appointed by the Legislature of the Commonwealth of Massachusetts, last Winter, the question of overhead wires came up, and experts testified on behalf of Storage Battery Companies against experts on behalf of Overhead Railway Companies, as to the danger or lack of danger in overhead power wires. A gentleman whom you all know came up as an expert and testified. The attorney for the Storage Battery Company brought in an affidavit from this person—it was not known that he was in the room then—wherein he testified to an enormous number of deaths having taken place by overhead wires. The chairman of the committee called for the gentleman—and I will mention his name, Mr. E. E. Ries, of Baltimore—a young man got up and said he was the gentleman. The Chairman said, "You have here testified under oath that *you* knew of so and so many people having been killed by electricity, state one, please." "Well," he says, "in Baltimore a man was killed by coming in contact with an arc light wire." "State the circumstances, please." "Well, I do not know them." "You do not know them," says the Chairman. "Then you were not present ?" "No, I was not present." "Well, where were you when this occurred ?" "I was in Boston." "How did you know this man was killed ?" The young man said, "I was in Boston and I read it in the paper." "State some other cases that you know about." "About a year ago a man touched a lamp in the Bowery in New York and fell dead." "What proof

have you got of this?" He took up the so-called "red-book" which was called a firecracker here at the last Convention, and also opened up Mr. Harold P. Brown's pamphlet, and said, "I have read it in these two circulars here." "And that is all you know about it?" Another gentleman testified on behalf of the State, at the Kemmler investigation, the other day, as to the intense danger of electric currents and the possibility of killing. That very same man, less than six months ago, before the same committee, was retained by a Storage Battery Company to testify that there was no danger in overhead wiring, no matter what the current, whether of high or low potential, and even if the wire was bare. The gentleman states there are numerous cases. I have here a case myself. Harold P. Brown, in a letter in the New York *Post*, dated July 5th, says a number of persons were killed by a certain kind of current. Telegrams were sent to these parties and replies received from them showing that the statement is not true. One case amused me very much. It was that of a man about whom I wrote to Mr. Brown the same day, regarding the facts. The man had touched a wire and fell face downwards in eight inches of water while intoxicated, and was drowned. These things all show that these statements want to be more carefully investigated.

MR. LYNCH: Will Mr. Alexander read a few more?

MR. DE CAMP: I want to ask Dr. Fell, the statement having come from him that several hundred persons had been killed—we won't question the number—and that they were killed instantaneously. That is the strength of your position, that particular point. That is the only evidence you say that you have. You assume that it can be done scientifically without pain.

DR. FELL: And from my own observation.

MR. DE CAMP: What evidence have you that these two or three hundred people were killed without pain; how do you get the knowledge?

DR. FELL: I can answer that question. Helmholtz had demonstrated that the electric current passes—or Wheatstone has demonstrated it—at the rate of 288,000 miles per second of time. It has been demonstrated to the mind and is now accepted by physiologists that the nerve current passes at the rate of 111 feet per second, or that it is 3,000 times less rapid

than than the electric current. . Now, when the nerve current is that of sensation, when we pass the electric current through the body, is it possible for the nerve current to overtake it?

MR. DE CAMP: That is not the question.

DR. FELL: Some people can ask questions that even doctors in Buffalo cannot answer sometimes.

MR. DE CAMP: I want to say I know of one man being killed, and he was killed unquestionably; but from all accounts I could get, that man in being killed suffered very considerably. It was not a painless death that he received in that case. As all these cases—I am not going out of the particular range of cases you mention—occurred under such peculiar circumstances that nobody, I think, is warranted in saying that there is any evidence whatever that these deaths by the electrical shock, such as received and reported in the papers, are painless. On the contrary, I think we have every evidence in favor of their being the opposite.

DR. MOSES: Dr. Fell has touched upon a very interesting point and one which can be settled and has been settled on just such fragmentary testimony as I gave a while ago in my remarks. It is admitted that the speed of thought, as representing the rapidity with which a current can pass along a nerve, is about the seventh of a second in the length of a human body—about 100 feet a second. Now there is no more accurate observer on record than Benjamin Franklin. There was no man more careful in a statement of facts, and I can elucidate it in just such a way as this: That when Franklin was on the eve of discovering the real reason for what is known as the Faraday experiment, he, with wonderful power of self-restraint, said, "this is an hypothesis and I will, therefore, not go any further." Such a man deserves the greatest respect, when he allows to issue from him a direct statement. Franklin said in that experiment I refer to, that he was looking at the spot where the current entered his hand. The distance could not have been more than a foot or two, and yet he did not see the spark, though light travels 200,000 miles a second. Nor did he hear the spark, which people said was as loud as the crack of a pistol, and yet he felt an universal blow. That was the current of thought—that spark. The impression of it did not go to his brain, but

yet the reflex action when he recovered consciousness, led to its being impressed upon the brain. Why shall we say because a man cannot come back from the borderland and tell us all his sufferings, that we know whether or not he has suffered, when we know that those who have returned have had the most intense agony.

There is one other point. We have all through the body little brains; all down the spinal column there are little collections of nerves leading to all parts of the body, that are, as it were, rudimentary brains, to such an extent that if you were to take the brain out of a rabbit and put your finger into his mouth, the brain that as a young rabbit would cause it to suck, acts. You will feel upon the finger the sucking action due to the action of this ganglion, which controls those muscles. Now there is a case of no brain, and yet an action as the result of thought. It is true that if the brain be paralyzed, nevertheless, throughout the whole body each nerve can be a thinking brain for itself, and able to give its own cry. I have just been told by the gentleman at my right that he has seen a death by electricity. That the man's cry could be heard for blocks, and yet there was no doubt of that man having been killed. Was that a mere spasmodic action? It may have been so, but I doubt it. I think it was the united action of every nerve in his body, calling for help at that moment. (Applause.)

MR. GARRATT: Mr. President, if there is any one thing in regard to this discussion which we are anxious to have, it is to have a fair statement from experts go upon our records. In answer to a question by Mr. Pope, I understood Dr. Fell to say, speaking of the death by gas, that in the preliminary stages before the asphyxia took place, it would be very painful. I should now like to ask the Doctor if, of necessity, the asphyxiation need take place before the insensibility. In cases of gas poisoning, take the simple and familar example of nitrous oxide (I might name several others, every chemist is familiar with them), where insensibility takes place first—where the direct action, upon the cerebellum is the first thing which happens, death must be without pain. I doubt if there are many people in this hall who have not become unconscious voluntarily more than once by nitrous oxide, what is known as laughing gas,

which, if administered in sufficient quantities, is fatal. Also, the effect of vapor of ether and chloroform, which is somewhat painful, although not so much so but that we voluntarily submit ourselves to it. I simply say, that of necessity, death by gas is not a painful death, which would call for "a cry from every nerve of a living body."

Dr. Fell did not reply.

MR. DEGENHARDT: I think these cries are due in great part to sudden fright. I refer to a case which came about in this way. Being in search of a gang of men at work in a basement, I walked into a dark place under the sidewalk and against a bunch of wires carrying a current of 210 volts. Immediately I struck the wires, I dropped to the ground and did not come to until 15 minutes afterwards. I decided that I had been scared to death, and I believe that these cries are due to sudden fright. My experience in the matter was confirmed by the fact that a few days after, I went into this locality and I handled this current without any difficulty at all. Possibly, a great many of these deaths can be traced to that action. In one case; Mr. Brown, of Chicago, will probably recall the case, a man was on a ladder and had hold of one support of a lamp. He reached out with his other hand, his foot slipped, and he grasped the side of the lamp and the man was shocked and dropped to the ground and broke his neck. There was no evidence that the current destroyed his life. His neck was absolutely broken. The man cried out for help. We were too remote to afford him that help, and the Coroner's jury brought in the verdict that his neck was broken. I am satisfied that from his long experience and knowledge of his business, it was a pure case of fright. He relaxed his hold when there was no necessity, and dropped to the ground.

THE PRESIDENT: I have a telegram for Mr. George D. Allen. Is Mr. W. J. Morrison in the room? If so, Mr. G. L. Rankin wants to meet him.

PROF. ANTHONY (Applause): Mr. Chairman, I have only a word or two to say. In the first place, in regard to the velocity of electricity. Dr. Fell made the remark that it was well known that Wheatstone demonstrated that the velocity of electricity was 280,000 miles per second. All of us know that such experi-

ments were unreliable. And that it is now perfectly well understood that it was not the velocity of electricity at all, but simply the time required for those wires to be charged, and for a spark to leap across the gap between the two wires. (Applause.) The velocity with which electricity passes over any given conductor is not known, and we know that that velocity depends upon a thousand things. In the first place, it depends upon the conductivity of the conductor; in the second place, upon the amount of pressure or potential; and upon many other things. The fact is that in the nerves of the human body the velocity of the electrical current is known to be immensely less than it is in a metallic wire. In a wet string the velocity of the current in passing over even a space of a few feet, is readily measurable, requiring quite a large fraction of a second to pass over a distance of even a few feet. I merely speak of this matter that it may go upon record, if these discussions are to be reported, that this question of the velocity of electricity cannot settle the point as to whether the death by electricity would be painless or not. I want to say a word in regard to another point. An execution of the death penalty, it seems to me, ought to be by some method that would not require experts. Now, is it possible, and is it likely and will it ever be possible, to have an electrical execution without bringing in electrical experts to prepare the apparatus and prepare all the paraphernalia before the execution can be performed? Would any one not familiar with electrical apparatus be competent to adjust the apparatus and make the necessary arrangements, even after the execution had been performed successfully once, twice or even ten times, by means of a given apparatus, would you then be willing to allow your sheriff at the next execution to put that apparatus in order, place the electrodes and touch the button which was to produce death. Would you find a sheriff anywhere in the State of New York that would be willing to take that responsibility upon himself. Could you find a sheriff who would be willing to fill this position? I doubt if, after 100 years have passed, electricity will be so understood by non-experts that they would be willing to take the responsibility of performing that act. Now, I say that an execution ought to be performed in such a way that the men whose duty it is to perform it according to the law, will be able

to perform it without calling in two or three experts. (Applause.)

Mr. Morrison: Our business requires that we should state our objections to the use of electricity for executions; and that these petitions should be divested of all flowers of rhetoric and all technicalities, and put in good, plain, straight English. I think that the case in hand ought to be treated from another standpoint, the standpoint of where this idea of executing criminals originated, and what was the motive of those who pressed it upon the Government of the State of New York. I did not desire, nor do I now desire, to take a part in the discussion of this question. I have given the matter little or no thought, but so far as I have learned, it was not a question of dealing kindly with the men you are going to deprive of life. It was not that the criminal might die a painless death. It was not that a benefit should be conferred upon the people of this and of other countries. It was to enable an individual to advance his private interests, and gratify his personal malice in pitting one system of electric lighting against another system. (Applause.) That is not a laudable ambition. Even if that gentleman should be elevated to the high rank of the Executioner of Paris, I doubt if it would pay him for the contempt he will earn for himself from the men whose profession he soiled. I do not desire to touch upon the question which has been raised, and settled to their entire satisfaction, by the medical and other scientific experts employed in this case. One point, however, the statistics of our business as dealt with—and it will be found in the records of our Association (this will be the second time to-day that I have asked you to read your own history), and perhaps you will find here and there a page bristling with testimonials which will serve my purpose; that is, illustrating the danger accompanying the use of electricity for any purpose whatever, whether it be for power or for anything else. A set of statistics were furnished here which read something like this: So many men killed by falling off a cross-pin, and breaking their necks on the pavement; so many men by runaway horses; so many by explosions; so many by flies getting down their throats and choking them to death, and so many killed by electricity. And amongst the deaths quoted, there was no business, and there is no business,

to-day, conducted on a scale of equal magnitude with that of electricity, that presents so few fatal accidents. (Applause.) In the city of Baltimore, we have had two accidental deaths in nine years. I presume that one of these was the case referred to by Mr. Reis. A light went out. I see a gentleman in the audience who was present at the time this trouble took place. A stable boy connected with the electric light station, in passing from his work on a terrible stormy night, saw that this light was out. He climbed the pole, and had heard the men say that by separating the carbons, the light would go on again. As usual with men in going up. a lamp-post, he threw his leg through the framework supporting the wire, and he also came in contact with the guy wire connected with the ground. It was a very stormy night, and probably some fault was on the wire. The man was killed.

Another instance was where a man was connecting up a live circuit—a thing which we are all apt to do at times, when necessity arises—he ran the service wires in the building, brought them out to the main line, and, for some reason, he handled the end of the wire with his hand, with the pliers, reached forward and cut the main wire, I suppose, expecting to secure it afterwards. The man was killed. That was a skilled lineman who understood his business from beginning to end, and knew all the dangers of it. He did precisely what a man would who wants to go out on the topsail yard-arm at night; instead of going on the guy rope he endeavors to walk out on the topsail yard, and he falls overboard and is drowned. In the meantime, at a hotel on Main Street, in Baltimore, the American Hotel, I think, a man was suffocated with gas. I deal with these things by name and date, and I have them all by date. Over in Old Town, at a hotel near Gay Street, I think on Center Street, there was a hotel with an incandescent system of lighting. For reasons that I do not care to give here (those of you who make or manage the finances of electric light companies can get at them), the current was turned off, and they resumed the use of gas. On that night a man and a woman took lodgings in the hotel, and when the servant went to call them they were dead, suffocated with gas, and five witnesses to the fact.

I could enumerate case after case, which would show that gas

is more dangerous than anything else that you use in daily life Everything that you use is dangerous; the food you eat; the whiskey you drink, or whatever it is you drink. (Laughter.) The water which you use, if improperly applied, is a death-dealing agent. Nobody would blame the bricks that the man is carrying up on the hod, if a man walking along three or four stories below happens to receive one upon his head and have his brains knocked out. A buzz saw does not make a very good seat for a man to sit down upon, but a man of sense will not sit down upon it. Electricity is not a good play-thing, if it is used for arc lighting or for power, or for any of these commercial purposes; but if it is used with judgment, with the ordinary safeguards which experience has thrown about it, it is as harmless as that wood upon which I lay my hand (indicating a piece of wood). Now, then, divest yourself of all fear of these things. Time will cure them all; after the men who have attempted to throw discredit upon a business which they claim will be their own lifetime business; after these men who have become volunteer witnesses; after these men who have practised every falsehood and every deception and have induced the highest people of this land to be sworn and volunteer as witnesses before tribunals who have never called for them, except upon necessity; after the men who have stained their names in this miserable endeavor to gain an advantage over a competitor in business, shall have passed away and their names, perhaps, in many cases, have been forgotten, electricity will be looked upon as a friend and benefactor to man. Warmth, light, power, everything that is desirable in man's life most, is furnished by this current which men are trying to persuade you now is so deadly. Our friends seem to lay particular stress upon the fact that the men who are advocating this execution business say that the current will kill a man. Of course, it will kill a man. So will a hangman's rope kill a man; so will the big knife over in Paris. That knife will kill people, and I think that is about as painless a death as anything I know of; one whack and away goes their heads. All these things bring you right here. We are dealing with an element which, if not properly held, will produce death. So will the ice which you buy in the streets. When you come to a question of painless death—a queston of legal punishment divested of un-

usual or cruel measures, as the lawyer puts it—I ask you if this is a painless death, and one not surrounded by unusual and cruel measures, when you have a perfect theatrical arrangement around the place where the man is to be executed. The very chair that he sits in would almost scare a man to death. Electrodes, looking like Holman's liver pads, put on each side of the head—everything calculated to terrify, to excite the worsts fears, so that he would be glad for the pangs of death to come and relieve him from the tortures to be inflicted upon him.

I rose to say that, of course, electricity will kill; anything that has power will kill; anything that has not power is of no use to man. (Applause.) I would have pursued this course from the beginning; I would ignore this man who has attempted to place this blot upon the prefession which he has disgraced. (Applause.) I should have gone to the men who employed him and said, "You cannot accomplish your objects by any such means or by any such instruments." I voted for the resolution in this Association condemning that sort of publication. I did it, because I did not think that the man who devised it was worthy of such notice, nor did I think that was the proper method of clearing our skirts of any such stain. But you have it with you now—a living issue. This law is upon the statute books of New York. It is with you to-day, and it is incumbent upon the electric light men of New York to get rid of it. It is incumbent upon the members of The National Electric Light Association to do everything in their power to get rid of it. Do everything that you can do to open the eyes of the Governor of New York, so that the case may be presented to your next Legislature, and enable this disgraceful law to be wiped from the statute books of a State which stands foremost in the civilization of this butt-end of the Nineteenth Century.

Mr. Robert L. Morris: Pardon me for making a short talk on the subject, but I cannot permit this discussion to close without saying that I question the wisdom of the action that this Association has taken on this proposition. I say that we ought to look the facts in the face just as they are. We cannot say that electricity will not kill. It will kill. So will a steam engine, and, as Mr. Morrison says, every power useful to man, if improperly used, will kill. Now, I question the truthfulness of the

statement that it is a degrading use of electricity to use it upon the criminal. If we can bring painless death to the criminal, then we are doing a philanthropic act, and then you are ennobling the use of electricity and not degrading it. A man who makes the rope might properly say you are degrading his business to hang a man with the rope. Now, I recognize the fact alluded to so forcibly by Mr. Morrison that this whole business grows out of the rivalry existing between two businesses—the low tension system direct current and the high tension alternating current. I am willing to say that the alternating high tension system will kill. Certainly it will kill. Suppose it does. As I said a while ago, the steam engine will kill. Still, while we smart Yankees are feeling our way along with a 1,000-volt current, our slow English brethren are putting up a 10,000-volt current, or ten times as strong as the one we are using. If a 1,000-volt current won't kill this man, let us make a 10,000-volt machine. I do not know any better place to begin than upon this man. Let us begin and experiment with this one, and then with the next one, and if we run out of criminals, then we may take Mr. Brown himself and experiment with him.

Mr. M. J. Francisco: In regard to the painlessness of this current, I know of a man who has received two shocks. In one case he let down a lamp running from a 50-light 2,000 candle-power machine. He was working on the wire when it dropped to the ground and burned through the insulation to the ground. Without thinking, he stepped back and picked up the wire, when he broke it off close to the lamp. He was standing on the ground saturated with water. Of course, that passed the entire current through his body, and where the wire struck his hand it bored a hole in his hand clear to the bone, and he became unconscious. We finally released him from the wire, and when he came to consciousness and recovered I asked him what the sensation was. He said, "There is no language that can describe it; it is beyond human language to describe the feeling of agony I suffered in the short time I was connected with that wire." There is a case where that man has received this shock and knows what the feeling is. Of course, if it makes him unconscious, and he feels the shock before he becomes unconscious, there can be no question about the fact of his sensation.

Mr. M. D. Law: I will describe a case that occurred to me in the last ten years, and only two of a great number of them. I have been knocked insensible several times. One of these cases was one in which I opened a circuit, or the circuit was opened through me by the carelessness of one of my men, to a 700-volt current through my hands. I laid insensible at that time ten minutes, they say. The other most important case was one in which I shunted the current of a 60-light Brush machine through my hands. At that time my first realization of any sensation whatever was the watching of my hands. The first thing that came to my notice at all—I was drawn all out of shape—I was watching and wondering if my hands would ever come into position again. Gentlemen, I don't want to go through that experience again. The pain was torture; it was terrible. In the case of that man of whom Dr. Moses spoke, of course, the current passed through from hand to hand. I have had it from the hand to the foot. In the case of this man, who was unfortunately killed, the current entered at the temple, passed through to the left hand. Now, I think that current, a current from about 50 lights, undoubtedly, was very close to the brain. That man yelled so loud that he could be heard about three blocks; his yelling was what brought the men to the pole. But he was unquestionably dead, because in the doctor's examination of that body in the coroner's testimony, I find that the blood was white—it was turned to water; the current was taken off immediately, so that there was no lingering current after death occurred.

Mr. Lynch: Mr. President, I think it would be a great deal more fitting and courteous, and bear a great deal more force, if the Association is to present the petition and resolution as presented by Dr. Moses, that they should be presented by a committee of this Association, and I move that a committee be appointed by the Chair, of which Dr. Moses should be chairman, and Mr. Wyman one of the members, to present the preamble and resolution to the Governor. Mr. Huntley suggests making it a larger committee, so that it would carry a great deal more force.

Dr. Moses: I would suggest that our Vice-President, Mr. Maher, who is in Albany, be added to that committee, or made the chairman of it.

Mr. Lynch: I would suggest that a committee of seven be appointed by the Chair, Dr. Moses to be chairman of said committee, and I would suggest that Professor Wyman be also a member of the committee to present this preamble and resolution to the Governor of the State.

Seconded by Mr. Huntley.

Mr. Pope: As I understand it, we are discussing a resolution which has not yet been passed. I would like information.

Mr Morrison: As I understand it, the resolution was passed when I was out of the room.

The Secretary was requested to read the resolution, which he did.

The President: I take it, gentlemen, that this motion of Mr. Lynch is to provide for special officers from the proper officers of this Association, to present this resolution to the Governor.

Mr. Pope: With all due respect to Dr. Moses, I would suggest that Mr. Maher be made the chairman of that committee, and I think the Doctor will bear me out in the belief that Mr. Maher would have more influence with the Governor than that committee.

Dr. Moses: The gentleman has stolen my thunder.

The President: It is understood that Dr. Moses withdraws in favor of Mr. Maher, of Albany, as chairman of the committee.

The motion was then put and carried.

The President: The Chair will announce the committee later.

Mr. Morrison: It has been suggested by the Hon. Mr. Ely, with whose name you are familiar, he having delivered the address of welcome, that a transcript of these proceedings, so far as they relate to this case, be furnished the chairman of that committee. That is to say, all these experiences such as Mr. Law and other gentlemen have given here, in relation to things they have seen and heard, be furnished to the chairman of the committee, and that they send them to the Governor and see what effect it would have.

Dr. Moses: I would like to say that I have an armful of responses that would almost fill the Governor's private office; responses to The National Electric Light Association, giving all the details, and if he takes the trouble to read these, that I have

taken to collect them, he will rise from the perusal with a horror that will not allow the ink to dry upon his pen before he signs the papers for the repeal of the law.

MR. MORRISON: The point is that that testimony is not the testimony of The National Electric Light Association. If you take the transcript of the records furnished from these members, it will have a better effect.

MR. WALTER C. KERR, (of New York): I rise to ask for information in regard to that resolution that we have passed, which is to go before the Governor. I would ask that the latter part, which was worded with considerable care, be given in the exact way in which it was worded, because that was about what we wanted; that is, where we petition that the Governor would commute the sentence to imprisonment for life until such time as this law is repealed. Would it not be better to word it, that the Governor should take such action as, in his judgment, would be sufficient for the protection of the law, without performing the execution by electricity, by not specifying how he shall do it?

MR. MORRISON: I think the point was raised before.

MR. LYNCH: I think, if Mr. Kerr would look at the resolution, he will find it means that such other persons who may be sentenced during that time, also may have their sentences commuted to imprisonment for life until this law has been repealed.

MR. MORRISON: The resolution is to abolish for the time being the penalty of death, until this statute can be repealed.

MR. KERR: The only question I raised was a legal one, and I am not a lawyer and do not know what it means when a man's sentence is commuted to imprisonment for life.

MR. MORRISON: He cannot be hung.

THE PRESIDENT: If there is no further discussion, with instructions to the Secretary to spread upon the minutes all the papers presented with the discussions thereon, we will pass this topic. A regular order of business interrupted the general discussion of the ideal central station. We will now proceed with that topic. Any one who has any question to ask Mr. Henthorne or Mr. Law, will now be afforded the opportunity.

MR. KERR: I was very much interested in Mr. Henthorne's paper; unfortunately, I did not hear the other paper I think

Mr. Henthorne's paper is one of the best engineering papers ever brought before this Convention. I would ask only one or two questions to bring out some points that are of interest in such a central station, which I think were not dwelt on in the paper. First, what provision is made and just how is it made, for the heating of feed water; second, what is done with the exhaust of the engine driving the condenser pumps, and whether that performs any function in feed water heating; and thirdly, why was the plan of wheeling out the ashes in large ash pans on wheels used, instead of mechanical conveyors? Those were the three questions occurring to my mind that may interest some of the members.

MR. HENTHORNE: In answer to the gentlemen's first question, I would say that the feed water when they are running under regular conditions, will pass through the economizer on its way to the boilers, and in the event of making it necessary to shut out the economizer, the water will pass through to the boilers at a temperature of that due to the overflow, which will be about 110 degrees. Then, as to the cost of the steam from the condensing apparatus. That we have arranged so we can put it directly into the exhaust line, or directly into the cylinder of the engine. In other words, when they are running ordinarily, the exhaust steam from the engine will pass directly into the reservoir between the intermediate cylinder and the last cylinder, the 33-inch cylinder. In regard to the matter of ash pans—our only object in putting that in was that we thought we could handle it to a little better advantage and cheaper than by putting the conveyors in; that there would be less to take care of.

Mr. Morrison here moved that the Convention adjourn until 7 o'clock, which motion was seconded by Mr. Kerr.

MR. C. J. FIELD (of Brooklyn, N. Y.): In regard to the steam plants in these two stations, I think there is an opportunity here for us to get some data of comparison in regard to the relative and true economy of high speed engines and low speed engines. We have had one side of it laid before us in two papers, claiming every advantage that could be claimed for the high speed engine over the slow speed engine, with single cylinders or compound, but we have not had an opportunity to hear from the other side, and as I happen to

be engaged in trying to put in what I hope will be a good steam plant, at an electric light station, I think it is an opportunity here to draw out some remark or some data as to where the true economy comes in. What we are trying to get in an electric light station, is a station that will be the best for dividends. We are not trying to spend the most money that can be spent on the plant, but trying to spend as much as will bring us the best returns. If we are going to spend two or three times as much for the result to be obtained from one style of engine as we could with another style, it comes down to the question of the relative steam economy of the two plants. We will grant the same boiler plant. It just comes down to the relative cost of the steam plant, and I would like to obtain some approximate data as to the relative cost of slow speed and high speed engines. Offset that difference in cost with the saving in steam economy, and I think you will find that it will be largely in favor of the high speed non-condensing or condensing. I think you will find such a plant as that laid out in Providence, and I do not think the cost (including all the plant, with its counter-shafting, etc.) would be far from $40 to $50 a horse-power. You could put in, I know, a compound high speed plant, 300 horse-power engine with good economy, for a cost of about $15 a horse-power. Now, is that difference in cost to be made up by any saving. As far as you can figure, it is in favor of the high speed, and as far as general theory goes, I think it is in favor of high speed. As far as wear and tear is concerned, I think there is not much difference. But the reserve plant to be put in, on the other hand, must be taken into consideration. I would be glad to hear from some other gentlemen on this question.

Mr. Henthorne: I think we will have to concede to the gentleman, that a slow speed engine costs more money at the outset than a smaller engine, from the fact that you have to put more material in, and the builder must charge more money for that additional quantity, but at the same time there are other matters that must be looked at outside of the question of first cost. There is the cost of running. This engine that we have at the station there has been guaranteed by the builders to develop a horse-power for 12.6 pounds of water, 12.6 pounds of dry steam evaporated or discharged from the condensing appa-

ratus. That is guaranteed by the builders. If you have a station that takes about 1,000 horse-power, one pound of water represents approximately $2,000 a year for every pound of water above 12.6—represents one per cent. dividend on $2,000 capital. If you increase that up to what a high speed engine would consume, or in the neighborhood of 17 pounds, possibly above it, there is a difference of about $1,000 in the running expenses. Of course, the engine that we put in there cost about $40 a horse-power. It is a three cylinder engine designed so that we could attach a fourth cylinder back of what is known as the last cylinder. That, of course, would necessitate heavier frames and additional expense. It was done that way so that we could carry eventually 200 pounds of steam pressure, and all our pipe and boilers are made for that. As I say, the boilers and engine cost about $40 a horse-power.

MR. FIELD: May I ask if it is claimed that the engines will give that economy under a varying load, which we would have in any electric light station.

MR. HENTHORNE: The guarantee covers a variation of 75 horse-power.

MR. FIELD: What are you going to get as the varying range which you will cover?

MR. HENTHORNE: We have not tried that yet.

MR. FIELD: I question what can be done. I know of a plant being laid out now with high speed and good boiler plant and economizers; it is expected to get down to 15 or 16 pounds. I think if you compare the cost of that plant with the cost of Mr. Henthorne's plant, and give it full credit for economy under varying loads, that you will grant that compound high speed will carry the wear and tear under varying loads. In fact, builders are all willing to guarantee it.

MR. HENTHORNE: There is no question at all that this engine of ours will require more than 12.6 pounds of water running on 100 horse-power. It merely comes down to the matter of multiples. If you have an engine that you can run regularly—if you have business enough so that you can run nearly the uniform load, say 425 or 475 horse-power, 10 hours a day, we think that it is policy to put in a first-class economizer engine in such multiples as you have business for. That is, if your business requires

multiples of 200 horse-power, put in 200 horse-power; if 500 horse-power, then put in 500 horse-power. It is merely a multiple, that is all.

Mr. Field: Is your plant going to attain such results—are you going to have such a load as that with such results?

Mr. Henthorne: I guess we shall come pretty close to it.

Mr. Field: And you are going to wait for future posterity to get the final economy under all conditions of your plant?

Mr. Henthorne: You cannot have the penny and the cake both. We think it is better to put in a first-class engine and run it under favorable conditions, as we can, ten hours a day, rather than undertake to spend a good part of the dividends in carrying along an invalid engine.

Mr. Field: I think, if you will compare for the next few years, and take your savings and offset it by what you acknowledge in the cost of plant, you will find the dividends in favor of the high speed plant.

Mr. Henthorne: I view it from the point of a central station manager. All we want is a plant that will give us the bigger dividends. I think we want, in a commercial view, to lose sight of the other problems as far as they conflict with that. Looking at it from a business standpoint, it seems as though the engine that could run for the less amount of water per horse-power, would be able to pay a dividend, when another concern, using a greater quantity, would lose money.

Mr. Field: Not if you have two or three times as much money to pay dividends on.

Mr. Henthorne: It is merely a matter of first cost, and what you will pay as interest, you will charge interest against it.

Mr. Field: I have figured it all out several times, and I have not seen a case yet where it will not come out as I stated.

Mr. Henthorne: One pound of water will yield a dividend of one per cent. on $200,000, with an engine that takes 16 pounds of water—you will not get that economy under a station load.

Mr. Field: There will be the same advantage.

Mr. Henthorne: No, sir; either one will give you a wider range.

Mr. Field: Suppose you put in a lot of small engines?

Mr. Henthorne: No, I want a 300 horse-power engine.

Mr. Field: This engine just happened to suit your particular place.

Mr. Henthorne: In our place, instead of putting in three, we started with five, and that five we propose to use when we can see it to advantage.

Mr. Field: What will you use when you are not using it? You have no other.

Mr. Henthorne: We think we can take care of 500 horse-power, without any trouble, as the minimum load.

Mr. Field: Then you are going to have at all times 500 arc lights to carry on that engine for 24 hours?

Mr. Henthorne: We have other business besides arc lighting.

Mr. Field: Well, that amount of power?

Mr. Henthorne: Yes, sir.

Mr. Field: I do not see where the economy comes in. I think this discussion is taking a very useful shape in an electric light station. I think we ought to look at the economical side as well as the engineering side. If you are using an engine that can run on 12.6 pounds of water, and a man up the street has an engine using 18 pounds, and if he can keep his lights going day and night without breaking down, he will lick you on your 12 pound engine every time, if you have a break down once a month. I am an engineer myself, and am very much in favor of economy on the steam end of the plant. That is where the money is made and lost. Twelve pounds of water as against 18, is undoubtedly a great factor and will pay a dividend if you can keep it up to that economy; but on that engine there are seven stuffing boxes and piston rods to look out for; there are in the neighborhood of 50 or 60 steam joints and jackets and pockets and everything of that kind to keep tight, and 12 valves to leak. The engine that I am using, and want to keep on using, is a compound engine, guaranteed to give 18 pounds of water; it has one valve to do the whole business. It has no stuffing boxes on it except one against the exhaust. It is internally lubricated, so that you use no oil except what is taken up by waste to oil the bearings. This engine can be run night and day, and the repairs are limited to using certain parts. Mr. Henthorne has a mill instead of an engine in the electric light station. A manager has enough to do to look after keeping his

lights going without keeping an engine to look after. I think it will be a question whether you can get 12 pounds of water for six months. I think that after the engine has run four or five months, some day the engineer will have the valve out on the floor for a few minutes, when his other piston will break down, and before he can replace that valve and start up again, he will damage his business more than he will save in water in 10 years. I do not agree with Mr. Law that the compound condensing engine is the most economical. We want to build an electric light station for simplicity in the machinery and get rid of everything we can.

One point of Mr. Law's paper I would like to criticise. That is the feature of his wires running from the dynamos to a switch board under the floor. If he carries his wires through to the floor below and strings them along the ceiling, then he has the best possible arrangement. I think for all ordinary purposes, however, they can be carried on glass cylinders. It is a very bad plan in any station to have concealed high tension wires. You want them open where hose can be turned on in case of fire. If it is necessary to run a high tension wire through a building, run it on glass insulators, but if concealed, cover it with a box which can be taken off at any time.

The insurance of electric light stations is getting to be a very serious question. I have had on an average two insurance agents a week, and they always want to know where the wires are. They think that an electric light station is a very dangerous place. I tell them I think the packing box factory next door is more dangerous than our place is. The ordinary fire risks are the real dangers in electric light stations. I do not believe there are as many plants burned down by electricity as by accidents from matches and things of that kind.

Mr. Law: That paper of mine was prepared in short order, and that point was overlooked in giving the description of the floor of the dynamo room. That floor should be left without any ceiling beneath it, and in our case was made of two-inch plank across the joist—a 1¼-inch floor laid diagonally across that. Our wires from our dynamos are carried through this floor in hard rubber tubing, on the largest size porcelain cylinders, on the lower side of the joist. Not only that, but it is the

very best insulated wire we could possibly secure. That point in your dynamo room where the wire leads from the dynamos and the wires on your switch board, is the most dangerous point that you have in the station. But, as Mr. Field says, the dangers arising from the ordinary fire risks are very much greater in an electric light station than those from the electric light wires. One other feature should have been mentioned in the paper, and that is a means of extinguishing fire. You should always have a good fire pump easy of access, plenty of hose, and plenty of fire buckets distributed about the place, and see that these fire buckets are kept filled. I nearly discharged one of my men very recently who had charge of the fire buckets for not having his fire buckets in good condition. Having your men well drilled is another great feature in an electric light station. At one time in my station I had a small spark occur beneath the floor. I do not think it came from a wire; still it may possibly have been a static discharge occasioned by the belts. When I saw the fire it was as large as my fist. By the time I got to it, it covered ten feet of space. I got out the fire hose; one man was with me and while he attached the hose I fastened the nozzle. We ordered the engine shut down as soon as I saw the fire. But when the engine shut down I had the fire out. In the meantime, it had extended up from the floor clear to the roof, through the belt hole. Had that fire had a start, say, until the fire department had arrived, the station would have been burned. These are the particular points in which your men should be drilled, and only men having responsible positions and men of good, cool judgment—men who do not lose their heads and who do not do things which ought not to be done.

Mr. Kerr: Speaking of the dangers of fire from electric light stations, Mr. Law has suggested one thing which we do not have, that is fire buckets. But we also have another thing that he does not seem to have, stand pipes to work with a reel of hose already attached, so that a man, simply with a turn of his wrist, has the water into the hose immediately. We do not have to stop to couple on the hose or put on the nozzle. Sometimes a nozzle may not be in its place and cannot be found. I shall also adopt the bucket.

A MEMBER: We do even better than that. Our hose is so arranged that when it is run off the reel it turns on the water automatically.

MR. F. H. BALL, of Erie, Pa.: I want to ask Mr. Henthorne a question. I noticed that he mentioned that this engine is guaranteed to deliver power at 12.6 pounds of water. Are your pumps driven by the engines?

MR. HENTHORNE: Yes sir.

MR. BALL: Then if that is so, a part of the power delivered by this engine is used by driving the pumps and that much of the power is not available, so that this result that he speaks of running under these conditions, the 12.6 pounds, is deceptive in operating that engine. Part of this power is absorbed in driving your pumps. It is not available for lighting. Another point. I would like to ask if he knows anything about the friction of this engine with its three cylinders, twelve valves and seven stuffing boxes and so on, and also the line shafting? Can you give me any information on that?

MR. HENTHORNE: No sir.

MR. BALL: It is evident that there must be considerable friction there, and in all probability the load could not be constantly kept up to the capacity of the engine. Wherever they are running with a part of a load, in addition to the fact that the economy would be considerably less, I would imagine that this frictional resistance, being a constant matter, the friction of your pump, counter-shafting, etc., I imagine that the economy of the engine would very much exceed 12.6 pounds. On the other hand, from an engineering standpoint, it would be very interesting to other managers to know what the consumption of coal would be per arc light per hour. These figures may be deceptive in regard to actual results.

MR. KERR: It does not seem to me that there is any discussion between gentlemen representing both sides of this problem as to subdivided power. It seems to me to be simply a question of the unit which shall be used, and Mr. Field is decidedly in favor of subdivision of the power. We are talking on the same line, and believe that nearly all the intelligent discussions on electrical power for stations are conducted nominally on the basis of subdivided power. It is only that one has different ideas of

the thing; and this comes from the difference in the stations. Looking at these plans of Mr. Field and what he has said about the Narragansett Company's station, there is a question raised in my mind, which is parallel to the other things in engineering ; that is, whether we are not sometimes tempted to consider a certain thing as an end rather than as a means to an end. An electric light station is simply a means to an end, and is not an end in itself at all. A great many of us have been in the shafting business some years and frequently have to sacrifice ideas we have of construction which would be very pretty and very beautiful to look at, but would also be expensive, and does not bring much return. We discard them because of their failure to bring a profitable return. The only criticism I would make of this ideal station—for it is certainly a model of engineering skill, and a fine station—is that it seems to be so largely an end in itself, a monumental piece of engineering work, like Stewart's house, in New York; but it may turn out to be an exceedingly desirable thing to build. If it does, so much more to the credit of the people who designed it and who built the machinery for it. An important question with that station would be its extension. We always have a lot of work in our business for posterity, but posterity never did anything for us, and when you begin to work for posterity, you begin to work on a very indefinite thing. We should work with an eye to an elastic station—one which can be extended. Build your station so that it can be extended in the future. The station which Mr. Henthorne has shown is an inelastic station, because it cost so much money that you cannot afford to change it. We know that what changes have been made in electric light stations in the last few years, have brought about an enormous improvement in electric light apparatus. Stations failing to make money at 100 to 200 volts, in certain districts, were able to pay on a 1,000 volt plant. But if they had to put in an apparatus which occupied a different kind of floor space, the machines could not go in in the same way they did before. A good many things have to be refurnished, and in some stations it costs a great deal of money; in others, a very little money. Now, the station which was the most elastic to begin with, could make these changes for putting in new electrical apparatus at a very low cost. Yet

I do not believe the time has yet come, nor that it will come within the next ten years, when we can build electric light stations as they do waterworks. The art is not far enough advanced. While I do not doubt that this is an excellent station which Mr. Henthorne has shown us, I would only criticise the general plan at all, in that it is too expensive for the present state of the art. Electrical discoveries may be made very shortly which will seriously impair the utility of that station, and it would cost so much money to change, that it never could be changed. That is the only objection I see to the use of it.

As to the question of striving for the greatest possible amount of steam economy, I have great doubt as to its utility. Steam engineering is not an exact science; so it is a very difficult thing for us to reason exactly what the ratio is between this economy of steam and some other plan of operation. We, however, do know, and it has occurred to me a great many times in the transaction of business, that, strange to say, the electric light companies that have made the most money are not the stations that have the most economical plants. It is a fact that the most economical plants have not produced the most money. If you go into the reason for that, you have to go so far that the reason becomes a little intangible, for the reason that men who have put in the lowest economy plants have paid more attention to some other branch of the business. I know of cases where 6,000 lights have been out in a single night in one city, where the results were extremely bad, where the loss could hardly be measured. There was certain important work going on which made the loss immeasurable. It sets them back in their business very seriously. I also know of a certain station composed of about 12 engines, two of which were very fine, 500 horse-power engines, high speed, simple type. The large engines in one year produced 12 stoppages of the plant which they drove, and the 10 engines never had a stoppage against them. It is a notorious fact that any plant which ever stops its machinery gets a low rate at which to furnish its lights, and a plant that does not stop gets a high rate. Consequently, the engineering of an electric light station must be considered from the standpoint of a good many things besides fine engineering. One of the best things about this station is the connections and general

arrangement, the steam pipe, and traveling crane, and all those accessories, which are not materially more expensive than the ordinary way of doing things. I think it would be a great saving to stations if they would adopt better methods of connecting apparatus, and pay more attention to how they put pipes together, and so on. How many times we have had a station shut down the whole night by an improper steam pipe. That is just as important as selecting a good engine or getting the boilers to evaporate a large amount of water to the pound.

These remarks are somewhat rambling in their nature, but I think you will understand what I wish to say. I do not wish to criticise the station which is shown us, from an engineering standpoint, because it is apparent that it is a very perfect station; but I criticise the expediency of building such stations in the present state of the art. I call attention, also, to the greater liability of stoppage where your unit is very large, and because you expect to do something for a posterity which never did anything for you.

Mr. T. C. Smith: Fire hose ought always to be coiled up ready for use, and we had it arranged so that the man grabbed the nozzle and ran away with it, and as soon as the hose was unwound it turned the water on itself. But the fire buckets are even more needed than the hose. It is the first pint of water you put on a fire that puts it out. The objection to buckets is that they are taken away from their places. There is one way to prevent them being taken away, and that is to put them in a rack and put bottoms on them so that the men cannot set them on the floor to wash their faces in. It is too much trouble to hunt up a couple of bricks to balance them on.

Mr. Lynch: I would like to make a remark. I don't know whether it comes under the head of this engine business, but it certainly comes under the business of the Association. I have been very much astonished to know, that notwithstanding the number of persons engaged in the electric street railway business, none of the companies seem to be receiving current from the electrical companies. A great many reasons have been advanced in my mind why it might be arranged so that the electric companies could supply current to the street railways. There seems to be a unity or consolidation of interest between

these people, and I thought there was great danger in the future of these street railway companies, by improved engines and motors, having stations in the center of cities, establishing a system of motor business, which would interfere very seriously with the electric light business. The great trouble has been that there has been no standard of electromotive force used by the railways. One company uses 400 volts, another, 415; another, 450; and another, 500. It is simply a question of what the inventor would like to use. The difference between 450 and 500 volts is so small that there was nothing in it. The electric light people have not wanted to supply these companies because they would have to buy different apparatus for every railway. It is not interchangeable. If four or five different railways came along I would have to have four or five different sets of apparatus, but if we could have a standard of electromotive force and four or five sets of large machines, we could supply a dozen railways. This power is required during the day time, when the electric light station is to a certain extent idle. It is a business that I would like to take up very much, and I have drawn up a resolution.

Whereas, It is the belief of the members of this Association that the electric motor service upon street railways will require a service of electric current for the motor that will be reliable and constant, and that the various electric light stations are capable of generating and distributing such current;

Resolved, That a committee of three be appointed by the President who shall endeavor to make such arrangements with the manufacturing companies, that they should adopt some standard potential to be used upon the various railways. The committee also to collect such data regarding the supply of current to railways as may be deemed of interest to the Association.

A Member: Mr. President, the street railways. have their own methods and their own complete system. I do not know of any people building or running electric railways who have a complete system of their own and they would not permit you to suggest to them the use of any other system.

Mr. Lynch: It is not the use of any other system; it is simply asking them to use a standard potential so that a man with 100 volts or 500 volts could supply a railway operated with either system.

Mr. Morrison: But the man who owns the railway won't let you.

Mr. Lynch: The street railway pecple know absolutely nothing about electric lighting. They go to the electric lighting man and say: "Will you supply us current?" He says he will not. I think it would be a move in the right direction to standardize the apparatus to be used by the central station men, if they can make any business of that kind with street railway concerns. It it is simply standardizing the potential of the street railway system, if that can possibly be done; they are not far apart at the present time. It is only the difference between 400 and 500 volts. You could drive one system with another system by simply making a little change.

Mr. T. C. Smith: I have had occasion, Mr. President, to inquire into this question a little with regard to the supply of current to street railways from electric light stations, and I found in nearly every case it has been purely a question of cost. The railroad people say electric light men want too much, and the electric light company says: "We do not propose to invest a lot of money in apparatus and tear our stations to pieces, unless we get a good price. I think that Mr. Lynch has made one very good point. The difference now existing is very small and I am satisfied in my own case they could secure contracts could they assure the street railway company that for so much a year they could rent power, instead of having to put in a new staff of engineers and fireman and a lot of people of whom they know nothing. I thought that a committee could do a good deal of good work in that way, not only among the manufacturing companies, but among the electric light companies and the street railway companies. There is no reason why an electric light station in the city should not supply all the current to be used in that city. It is undoubtedly true that most of the street railway companies do run within 50 volts of one another. One of them says, if they run up to 500 volts the drivers would run the cars too fast.

The President: The progress made in this direction would be slow and encounter a good many obstacles. I still think the tendency of the times is towards standardizing. We can remember when railways were all sorts of gauges. We now have

them of standard gauge, and all of us who are in the business know what a multiplicity of differences we have, how difficult it is for a man who has had his service from one system to get service from another system. He has to go to the expense of changing a good many things. There has been some talk abroad on this same topic, and I think some good will come in the way suggested by Mr. Lynch. I know we will have the interests of the manufacturing companies to contend with, as each one is striving to give somebody something that he will have to renew only through him; their interests are all in that direction, but it is only a question of time, gentlemen, before these things must disappear. They must come to a certain standard which will be the result of the experience of all and will be dictated by economy. It seems to me that the resolution offered by Mr. Lynch is in the right direction. And while, as I say, I think the progress of this committee must necessarily be slow, as the work is arduous, I think it should be put through.

MR. MORRISON: I do not think the committee will accomplish anything. That is the only reason I object to it. You appoint committee after committee, and do you find them surmounting all the obstacles in the way of making a clear report of the work done? No, you find the majority of them, where the work is very difficult, coming back here and making no report. They only make excuses for their inability to report. I would rather see no committees appointed than see committees appointed and no work accomplished by them. However, if you put Mr. Lynch and others on it, I shall look forward with interest to see what excuses they will put forward at the next meeting for not performing the work.

MR. SMITH: I fully appreciate the honor Mr. Morrison has done me having made good excuses for our not doing anything, but this thing is one that you can bring home to your electric light companies, and electric companies generally, with some pretty forcible arguments. One is that in one city I saw a report recently, that a street railway, as a part of the conditions on which they were permitted to change from horses to electric cars, agreed to put an arc light on every corner. They went to rent those lights from the electric light company, who had an exclusive franchise, and found it would cost 60 cents a light.

They put in a dynamo, and found it cost 14 cents. How long is it to be before they are running lights and renting them to consumers along the line? Just as soon as they find they can do it successfully, they will sell light. I suggest that on the standardizing of these machines you could appeal to the manufacturer also. When a man is running an arc light system, using 10 amperes of current, and another man comes along and tries to sell a dynamo that takes 20 amperes, the first thing is there must be a whole new set of lamps. But another man has a 10 ampere system, and he says, "you can put my lamps on your dynamo," or "my dynamo on your lamps." If the manufacturing companies object to the standardizing, it is because it would enable them to knock some other fellow out. I hope the resolution will go through.

THE PRESIDENT: You want to suggest that it will give them a wider market for their apparatus. Recently a company was formed to develop a certain district adjacent to our city. They came to me to know if I could give them power. They had not money enough to buy the whole plant, but they had money enough to lay the track and equip the line. I could not give them power for the reasons stated by Mr. Lynch and Mr. Smith, and the result was that the manufacturers did not sell them the motors and the other appliances.

MR. KERR: I would call attention to the fact that standardizing is uncommon since by it certain machines could be duplicated by others. Engine builders use the same standards of nuts, bolts and threads. Take a thing from one engine and it will always fit another engine.

MR. LYNCH: I think the overhead wire problem is coming to electric light people in almost every city and town in the United States. Street railways are already being put up by that system with a double line of poles on each side of the street. If there could be any arrangement by which the electric light companies could co-operate with the railway companies, it would simply save the electrical companies from the underground troubles. You have got to have the street railways, it is really a necessity, but people say they can get along without the electric light.

(The President put the motion of Mr. Lynch on the resolution

to vote, it having been duly seconded, and it was carried. The Chair appointed Mr. Lynch as chairman of that committee, and as the other members, Mr. Smith and Mr. M. J. Perry.)

MR. MORRISON: I move that a committee of five be appointed to present nominations to the Convention for officers of the Executive Committee, and to suggest a place of meeting for the next Convention.

(This motion being duly seconded by Mr. Lynch, was carried.)

THE PRESIDENT: The matter brought up by Mr. Lynch was a little out of order. It should come up under the discussion to be held this evening of electric railways—the electric transmission of power. It interrupted the closing of our remarks on the question of the Ideal Central Station, that is still before the Convention. If there are no further remarks on the question, the topic will be closed with instructions to the Secretary to spread the papers and the discussion on our minutes.

Secretary Garratt then read the following letter from Mr. William Bracken, of New York City:

NEW YORK, Aug. 5, 1889.

ALLAN V. GARRATT, ESQ.,
Secretary and Treasurer, National Electric Light Association.

Dear Sir: I regret that I am prevented by business engagements from being present at your meeting to-morrow. I send, however, as my representative, the bearer of this, Mr. S. Marsh Young, who has been for some time in the service of this company, and who will read my paper on Storage Battery Traction, at your meeting.

Trusting you wili accord him the same privileges that would be extended to myself, I remain,

Yours very truly,
WM. BRACKEN, President.

Mr. S. Marsh Young was then introduced by the President.

MR. S. MARSH YOUNG (of New York): As the Secretary of the Association has announced, I am not Mr. William Bracken, but I have the pleasure of representing him and expressing to you his sincere regrets at his inability to be present. I personally regret that such is the case. The subject of storage batteries is one of such growing interest, not only to the electric and mechanical fraternity, but to the public in general, that I feel he should be here this afternoon as the very best representative in this country to represent the subject of storage battery traction.

To follow up a little the discussion here on the subject of supplying street railway from central stations, I must take exception to a certain extent to Mr. Lynch's statement when he says that all street railways are destined to be run by the overhead system. There is another question which I think will interest you. This is practically the first paper which has been read before you at this meeting on any subject outside of electric lighting, and, therefore, you may think for the moment that it is a little out of place for me to read a paper on the subject of storage battery traction, but I think there is one point you should bear in mind, that there are to-day 30,000 cars in the United States, and every car takes six to eight horse-power to propel it, and the question is, how is that power to be produced. The question of the production of that power is a simple question of cost. The distribution of all energy is, I think, tending towards centralization. I think the time will come when you will find in each city one well equipped station, rather than the present competing companies. The competition of gas will always keep the supplying of electricity down to a low cost. With a station situated on a water front where the haulage of coal is reduced to a minimum, where high speed engines can be used, the street railways will be supplied with current rather than by individual street railway companies. Mr. Bracken's paper, which he has prepared to be read here, I will take pleasure in delivering with these few preliminary remarks.

Mr. Young then read Mr. Bracken's paper, as follows:

STORAGE BATTERY TRACTION.

BY WILLIAM BRACKEN.

Mr. President and Gentlemen:

I have been invited to address you on the subject of Electric Traction by Storage Batteries.

It has been customary for speakers on Storage Batteries to begin their discourse by apologizing for their subject. That day has gone by. The Storage Battery has no longer any apologies to make.

My purpose at first was to give a detailed account of the progress of Storage Battery Traction, by going back to 1881, when the first storage battery car was run, and following up the history of improvements from that time to the present. But I have found it impossible to get full and reliable data as to the work accomplished in Paris, in England, or in this country. I wrote to almost all the companies and individuals who have been engaged, or are now

engaged, in storage battery traction, to send me full accounts of their experiments and work; but I regret to say that only one responded to my request, and that was Mr. A. H. Bauer, who gave me a very interesting account of his experiments with his storage battery car, in Baltimore, in 1885-86. The published accounts of the operation and experiments of storage battery cars in Europe are so obviously inaccurate, as to be unworthy of re-production. There is one exception, however, to this, and that is the account given by the Jury of Commissioners at the Antwerp Exhibition of 1885, on the work of the storage battery car exhibited there; but as you are all more or less familiar with that report, I will make no further reference to it. I am, therefore, compelled to confine my remarks to my own observation of storage battery traction. I will not weary you with threadbare information. I once heard a judge tell a loquacious lawyer that he must assume the court knew *some* law. I will assume that you have a pretty general acquaintance with the storage battery in lighting and in traction; but there may be some features, chiefly commercial, that have not come under your observation. My observations cover a period of over three years, during which time the Company with which I am associated has directed its talents and energy to the development of storage battery traction. You all, no doubt, appreciate the difficulty of the task—not alone difficulties inherent in the system itself, but difficulties arising from the skepticism and lack of sympathy, I regret to say, of a very large majority of the electric community. We all know how much skepticism on the part of street railway men has had to be overcome in electric traction of every kind. It has taken a great deal of hard work—of missionary work—on the part of electrical engineers and inventors to bring about present results. But this is not to be wondered at; for there is nothing harder to accomplish than to supersede an old and well-established system. The horse car had plodded along and gathered strength and influence just as it had gathered fares. That influence was widespread and almost all-pervading; for there is hardly a town on this great continent that has not its horse car line. The horse car system had been spreading for about 50 years, and when it came to be in full and undisputed possession of the field, can it be wondered that those men who had the hardihood to attempt to supersede it, should be regarded with more or less suspicion—should be looked upon as pretenders—especially when you consider that the method which they propose to employ was electricity; that dark and mysterious science, as many people, even now, regard it.

Now, the first experiments made with electric cars were calculated to increase this suspicion and to throw disfavor on electric traction ; for it is a characteristic of inventors to be so far carried away by their enthusiasm as to commit great indiscretions in carrying on experiments in public, which really should be conducted in private. It was on this account that the early experiments of Daft, in 1883, and of other well known electrical engineers in succeeding years, while they created wonder, did not beget confidence. I may say, without any invidiousness, that two years ago there was not a single electric car run in this country that proved anything more than possibilities.

There were probably two dozen cars being run at that time by the overhead wire system, but so unsatisfactorily, that people who went to see them, came away, shaking their heads with distrust. Now, all this distrust has disappeared and electric traction has grown so fast, that to-day there are no less than 100 street car lines in this country that are either running their cars by electricity, or are in the course of introducing the system. Electric traction has, beyond all doubt, come to stay; as the French say, it has arrived. But the large cities are threatened with the cable. The storage battery proposes to challenge its supremacy.

There is a very general popular misconception of the nature of the storage battery. I suppose that at least 90 per cent. of the public have an idea that storage batteries are nothing but buckets full of electricity. We read in the newspapers, from time to time of storage battery cars carrying "tin tanks" filled with electricity. There can be no greater misconception of the nature of the storage battery. The clearest idea I can give you of the energy contained in a storage battery is to compare it with a lump of coal. The source of energy in a battery is identical with that contained in coal. It is merely energy locked up in a number of substances, principally the metals which, when set free in a certain manner, manifests itself in a certain phenomena we call an electric current. The metal almost universally used in the storage battery, is lead in its various forms. In this lead is contained latent energy, the same as in coal, and if we compare the amount of work accomplished by the energy from either source in foot pounds, we will find it to be exactly equal in both cases. Now, the general principles involved in a storage battery are very simple. When we charge a battery from a dynamo or other external source of electricity, we are manufacturing lead, and when we discharge a battery through an electric motor or series of lamps, we are simply burning lead. But there is this difference between the action of coal and lead, that whereas coal apparently disappears when burnt, the lead does not, but is converted into sulphate of lead to be converted back to metallic lead again by a reversal of the current, so that the storage battery is alternately burning and reducing lead to and from one of its salts. This is why the storage battery lasts and does not disappear in the contraction of the energy, as coal apparently does. In fact, the storage battery is an ideal illustration of the conservation of force and the indestructibility of matter.

When the storage battery first became known, in a practical and commercial form, by the experiments of Plante, in 1859, scientists foresaw for it a great future, and when corporations were formed later on to exploit and introduce the storage battery, the people of Europe, influenced by what might have been considered the extravagant praises of Sir William Thomson and other well-known scientists, put an enormous amount of capital into storage battery enterprises. Almost all of those enterprises, however, proved to be commercial failures; first, because the exploiters were ahead of their time; and, secondly, because the public were led to expect more than the storage battery, in its then crude form, would do.

There probably have been few things more difficult to accomplish than to

bring the storage battery to its present stage of commercial value. Notwithstanding all that had been written about its nature and characteristics, its treatment, both in its manufacture and use, has, until very recently, been purely empirical. That stage, fortunately, has been passed; so that, with intelligent care, the storage battery to-day is not only a valuable adjunct in lighting, but is becoming a very prominent factor in traction.

The advantages of storage battery traction, assuming that it is practical and economical, are too obvious for me to occupy your time in recounting.

The obstacles in the way of success of the system are largely, if not wholly, overcome. The chief of these, was the *handling* of the batteries. That was the most difficult and the last obstacle to be overcome. Two improvements removed these difficulties. First, the *flexible conductor*, by which it is possible to couple up or remove cells with great rapidity, and secondly, the battery rack, occupying a floor space of 24x7 feet on each side of the car, wherein can be stored a sufficient number of batteries to run from 10 to 20 cars, according to its location. This rack represents stall room for 150 horses, or say, 6,000 square feet. I regard this rack as the greatest improvement hitherto made in storage battery traction. By its aid we remove the batteries from a car and replace them by another set, in from two to three minutes. Indeed, the cars on Madison Avenue, New York, have to leave the station on six minutes headway. In the afternoon trips, there is but six minutes interval between their arrival and departure; and they all receive their batteries from the same rack. When the car enters this rack, its panels are dropped down on either side and thus form bridges over which the batteries are withdrawn from and replaced in the car. While this change is being made, a competent person inspects the regulators of the car. The motors, gearing and connections are only inspected once a day, and that at the end of the day's work. You will thus perceive that the great bugbear of how to store the batteries is no longer an element in storage battery traction.

From my observation of the recent work on Fourth and Madison Avenues, now that a number of cars are running, and under very unfavorable conditions as to station room and the like, I am led to believe that the storage battery car is as free, if not freer, from accident, as cars that are run by the overhead system. The motors are, I think, subjected to less trying conditions, owing to the fact that the E. M. F. is always uniform. The batteries never give out on the trip. It is impossible for them to do so, as they leave the station with 35 electrical horse-power hours stored in them, and do not consume quite 12 in the round trip of 12 miles. The battery in service has never been short-circuited. When the current required exceeds 150 amperes, the battery is automatically cut out. When rigid connectors were used, breaking was frequent, and the flexible connector has, until recently, given some trouble, from time to time, by jumping out of position while the car is in service; but with recent improvements, disconnection of the batteries while the car is in service, is now rendered almost impossible. For several months past the regulators have caused absolutely no trouble. In any event, there are two on the car, so that if one should fail, the car may be operated

from the other end. You will thus perceive that the likelihood of accidents or breakdowns is reduced to a minimum. The first standard car has run in three months over 6,000 miles and carried over 80,000 passengers, never having missed but one-half a trip in that time; and that arose from a bent axle. It has never had an accident or stoppage of any kind while in service. Do not be skeptical at the assertion, when I tell you that not a dollar has been spent on that car in the way of repairs or alterations.

At this stage you will naturally ask, how about the life of the battery? I answer that, from our observation, we have nothing to fear on that score. A life of six months from the positive plates is sufficient; it is found that they will last very much longer than that. The chief reasons why the short-livedness of a storage battery has been so much talked about and feared, is that it has, until recently, cost so much to manufacture the battery. Now, the material for your battery you have to buy, in a great measure, but once, for the reason that the discarded battery can be made over new. The raw material in two sets of battery, capable of running a car 120 miles a day, costs, exclusive of the containing jars, about $300. Have you machinery and devices requisite for manufacturing this raw material cheaply into a battery? If you have, you need have nothing to fear on the score of economy. It will cost $4,000 to purchase enough horses to run a 16 foot car 120 miles a day; it will cost about $1,500 to purchase enough battery to do that work. The batteries can be maintained for about one-half what it costs to maintain the horses; and by maintaining I mean replacement as well as feed. This I know for a fact. Can we then have any further doubt as to the relative economy of storage battery traction?

The cars on the Madison and Fourth Avenue Line, take one electrical horse-power hour per mile. The road has some long gradients. The grade at Centre street is over 4½ per cent. and 600 feet in length.

The cost of motive power for a car day of 75 miles; we estimate at $3.40, as against $7.50 for horses. Five dollars for 75 miles ought to cover the cost in Winter. By motive power we mean the cost of energy at two cents per horse-power hour, and $700 per annum for maintenance of batteries and motors. To those who may think that two cents per horse-power is a low estimate, it may be said that power has been offered in New York, to be delivered at the station at the price above named. In towns outside of New York, offers have been made to supply current at low figures. The more level the road the cheaper obviously will be the cost of motive power. This is more particularly true of the storage battery, which, in excessively steep and long grades, becomes heated. The chemical energy, instead of exhibiting itself in the form of electrical energy, exhibits itself in the form of heat, with consequent injury to the battery. Cars will ascend very steep grades, but it is not deemed economical to attempt grades of more than six per cent., and they must be short at that rate. But there are few roads offering more and steeper grades than the road we are now operating on in New York. Each car has two sets of battery. A set is easily charged in about two-thirds of the time the other is in service. No time is lost in charging as the battery is automat-

ically put in circuit with the dynamo as soon as it is withdrawn from the car. Now that there is a complete group of cars in service in New York, and it is hoped to follow those by another group of ten, more will be known about storage battery traction at our next annual meeting.

Mr. Morrison: Mr. President, it has been the aim of this Association to prevent it from being used as an advertising medium by any manufacturer or by any person exploiting his own private affairs, or representing a corporation distinct from any other corporation. It is a difficult and delicate matter to suggest anything in regard to the paper that has just been read, but I presume that we can cover the ground something like this. The paper is a thorough description of the Julien system. It goes further and shows the advantages of that system over any other system. I move you, sir, that that paper be referred to a committee composed of Mr. Young, the Secretary, Mr. Garratt, and the President, to divest it of some of its pointed personal features.

Mr. Young: Mr. President, if I may be allowed to make a remark—this paper was intended to be a very general paper on this subject of storage battery traction, and we corresponded with every one in this country who has been making experiments with storage battery, and we informed them that we would be very much pleased to quote in their own words any suggestions or experiences they might have. I do not want to say anything further in regard to the Julien system, particularly after what Mr. Morrison has said. But the Julien system is the only system that has done anything practical in the way of storage battery work—that is, that can say it has done so and so, has carried such and such passengers, and run so many miles of regular passenger service. Now, it is simply from that fact that the Julien system is the only one from which I can obtain any details, for the reason that it is the only one that has practically put its whole energy, heart and soul into the subject of storage battery traction and that has made it what it is to-day. It is because I have no other grounds to take. If there is any other company in this country who has made storage battery a specialty, I will be glad to quote from them.

The President: If there is but one company, why name it?

Mr. Young: If I did, I did not intend to at all.

Mr. Morrison: I think, if Mr. Young will permit me, the difficulty can be gotten over by the conference between Mr Young and the Secretary and the President.

Mr. Duncan: Mr. Chairman, may I rise to a point of information? Has that paper passed through the proper channel, as is the usual custom with papers in this Association?

Mr. Morrison: No, sir.

Mr. Duncan: Then why was it read?

The Secretary: In conference with the Executive Committee, certain men were picked out to read papers on topics of general interest. Mr. William Bracken was selected as one of the best informed men in this country for this subject, and he was requested by me to write a paper and present it on the 25th of last month, that it might be read and approved. He wrote a courteous note and also requested several of his young men to come up and see me and explain that it would be utterly impossible for him to do so. The paper has never reached me. I understand it has only just been finished.

Mr. Duncan: Then it is not properly before this Association, as I understand it. I am simply endeavoring to understand the matter.

Mr. Morrison: There is no law in this Association that describes the method by which these papers shall be handled.

Mr. Duncan: Except that of custom and precedence.

Mr. Morrison: Then a paper is properly before the Association when the Chair calls upon a gentleman to read it.

Mr. Duncan: I think the custom of the Association has been to have all papers to be read submitted to the Executive Committee, who shall go over the papers and eliminate objectionable matter, just such matter as has come up here this afternoon. If this paper has never been before the Executive Committee, and if there was a reasonable excuse, it should have been presented to this body before that paper was read, and our action taken upon it. I shall, however, second the motion to refer to a proper committee to eliminate the objectionable features in regard to distinguishing certain companies. That is one thing I have taken in hand frequently myself. I wish to call attention to the fact that this paper has not gone through the proper channel.

Mr. Lynch: In order that the members of the Association

may not get an idea that notwithstanding the fact of this precedent, that the paper should go into the hands of the committee, has not been carried out in this case, I will state that I went over the papers myself on Monday afternoon and there were so many of them that I was very glad there was not another one. About this paper there was probably some error in the understanding of Mr. Young, and in the hurry of the moment it has been neglected. I think we have taken a rather extreme view of many of the statements made therein, because I know that many of the facts bear out his explanation of the manner in which the Julien Company appear in this article. They are the only railway company engaged in actual practical work. There are several experimental companies making cars, etc., but they have not completed the work.

MR. YOUNG: May I answer Mr. Duncan? The reason why this paper was not presented through the regular channel of the Executive Committee, was, that when I came up, Mr. Bracken had not quite finished his paper, and he informed me that he would send it to me. I only received it this morning. I expected to see your Secretary before I read the paper, but coming to me a few moments ago, he asked me if I was ready. Therefore, I must apologize, for being a new member I may not be familiar with all the rules of the Association.

MR. DUNCAN: I will be happy to accept the explanation.

MR. MORRISON: I do not look upon it as a serious case. A custom has prevailed. We have followed that custom. In this case the paper is one containing a great deal of information, which it is necessary for this Association to have to enable it to reach proper conclusions. There are some little details that can be changed very readily, and the objectionable features of the paper can be removed—that is all. Let us take the short way of straightening the thing out.

THE SECRETARY: Mr. Bracken and his representative have acted in perfect good faith with the Association through me in trying to get that paper to me. I did not receive it—that is all.

MR. DUNCAN: I rise simply to state that the explanation of the gentleman who read the paper of the conditions under which the paper was presented, and the fact that I had already seconded Mr. Morrison's motion was entirely satisfactory, and having

drawn the attention of the Association to it, therefore, I am perfectly satisfied.

THE PRESIDENT: I think the custom made by Mr. Duncan is very well made, and while I myself have never conformed to it, I think it is a very good custom, and I think that the point made by Mr. Morrison is well taken. I also take it that at a conference with Mr. Young, we can easily remove the objectionable features; that is, remove the personal mention and make some slight changes. The paper is very valuable and comes from the only source from which we can get the information. We want the paper, but we want it in proper form, of course.

The motion to refer the paper to a committee of three having been duly seconded, was put and carried.

THE PRESIDENT: Before a motion to adjourn is put, the Chair would like to announce that the Secretary will furnish, on application, to members copies of the proposed amendment to the Constitution, which will be a special order of business for to-morrow at 11 o'clock. I am also requested by Chairman A. R. Foote, to announce that the Committee on Electrical Data will meet in parlor B, of the International Hotel, at 9 o'clock in the morning.

I would announce as a committee to nominate for the Executive Committee and to choose a place for the holding of the next convention, the following: Chairman, Mr. Morrison, of Baltimore; assistants, Mr. Lynch, of New York; Mr. C. Martin, of Parkersburg, W. Va.; Mr. Peck, of Brooklyn, and Mr. De Camp, of Philadelphia. A motion to adjourn will now be in order.

On motion by Mr. Lynch, duly seconded, the Convention adjourned, to meet at 7 o'clock this evening.

The President, immediately after the adjournment, announced as the subjects for discussion at the evening session, Electric Railways and the Electric Transmission of Power, by Mr. Mansfield and by Mr. Roberts.

SECOND DAY'S PROCEEDINGS.

EVENING SESSION, AUGUST 7TH, 1889.

The Convention was called to order by the President at 7.30 o'clock, but was adjourned until 9.30 o'clock to-morrow.

THIRD DAY'S PROCEEDINGS.

MORNING SESSION, AUGUST 8TH, 1889.

The Convention was called to order by the President at 7.30 o'clock, A. M.

REPORT OF NATIONAL COMMITTEE ON STATE AND MUNICIPAL LEGISLATION.

BY A. R. FOOTE, CHAIRMAN, OF CINCINNATI, O.

In presenting the report of the Committee on Legislation, I have written what may be called a summary of the steps taken to organize that Committee. In doing that work a certain number of circulars were used, copies of which I have here, and they are exhibited as a part of the report. With the permission of the Convention, I will omit reading those, as most of them have been printed in the electrical journals. They are only attached to the report to have them brought in properly as a part of the business of the Convention. If there is no objection I will read that part which is new to you:

"*Whereas*, In no State, so far as can be ascertained, are the laws properly drawn to enable municipalities to contract with incorporated companies to perform services for cities and their citizens upon a sound, economical basis, be it

"*Resolved*, That a Committee on State and Municipal Legislation be appointed, consisting of one member from each State, to operate together, to secure such Legislation in each State, as may be required, to enable municipalities to contract with incorporated companies to perform services for cities and their citizens, on the sound, economical basis of securing to such companies an undivided demand, an unrestricted privilege, and a permanent investment." (See Proceedings of Ninth Convention, vol. 6, page 199.)

This action was taken so near the close of the Convention, that there was no opportunity to discuss the measure or to secure a properly appointed Committee. To form a nucleus for the Committee, President Duncan appointed Mr. A. R. Foote, the member of the Committee for the State of Ohio, and named him as chairman, with power to appoint one member for each State. This, at least, was the understanding, but I find no record to this effect in the published proceedings of the Convention.

Thus commissioned, I at once commenced the work of organizing the Committee, by requesting those with whom I came in personal contact, before leaving Chicago, to nominate members for the Committee. The names of a few persons so nominated, were taken by the Secretary, and published on page 4 of the proceedings of the Convention, as members of the Committee. All but three—Mr. Officer, of Council Bluffs, Iowa; Mr. Moore, of Plainfield, New Jersey; and Mr. Truesdale, of Washington, District of Columbia—have accepted the appointment, and are now registered as members of the Committee.

It was quickly apparent that some persons, thought to be desirable to act as members of the Committee, were not members of the Association, and that there were some States in which the Association had no members. To provide for both of these contingencies, the plan was adopted of nominating the person wanted, whether he was a member of the Association or not, and then to request him to become a member at the time of notifying him of his nomination as a member of this Committee for his State.

To secure the approval by those responsible for the welfare of the Association, of every step taken in the organization of the Committee, and to be able to profit by their advice and co-operation, the method was taken of submitting to them, before making further issue, in duplicate, printed forms, copies of which are attached, as a part of this report, marked as exhibits.

A comparison of these forms will show the changes made in them, after they were submitted for examination and criticism to the officers of the Association and the members of its Executive Committee.

When these forms were sent to the officers of the Association and members of the Executive Committee, they were also sent to a number of persons known to be deeply interested in the welfare of the Association, and who had an acquaintance with persons throughout the country, interested in the electric industry. When the forms were printed for use, they were also sent to the electric press, and were favorably commented upon, while some publications printed them in full.

All names suggested from any responsible source were at once placed in nomination and the appointment tendered to the person named, provided an appointment had not already been tendered to another person in the same State.

As a result of the first issue of letters tendering the appointment, there being 40 names on the list, 19 accepted the appointment, 4 declined, and 17 failed to respond. Of the 19 who accepted, 11 were members of the Association, and 8 became members after accepting the appointment.

After the expiration of the date fixed for responses to the *first* issue of letters tendering the appointment, a new list of nominations was printed, showing all who had accepted the appointment, and those who had failed to do so. This list was sent to all persons who had formerly been addressed upon the subject, and was accompanied by a circular, headed, "Encouragement—Appreciation."

After the date fixed for responses to the *second* issue of letters tendering the appointment, a new list was printed, showing those who had accepted, and leaving a blank for the States for which there was no acceptance. Accompanying this list, a circular was sent, asking each member of the Committee to make suggestions regarding the organization of the Committee and its plan of work, and giving notice that the first meeting of the Committee would be held on Tuesday evening, August 6, at 7 o'clock, at the International Hotel, Niagara Falls.

In this list of 42 States and the District of Columbia, there are but 12 blanks. Of the 31 members of the Committee as now reported, 15 were mem-

bers of the Association, and 16 persons became members after accepting their appointment as a member of the Committee. This history shows the successive steps taken in organizing the Committee. It also shows that the Committee as now constituted, is the product of the co-operation of many devoted workers and clear headed thinkers, who are giving life to the Association, by donating to it a part of their own.

As the initial step for the practical work of the Committee, the following letter was addressed, July 19, to the Secretary of State of each State:

"DEAR SIR—Will you kindly oblige me with a list of the bills, by their title only, affecting in any way, the interests of the electric industry, which were introduced in the last session of the Legislature of your State, and the simple statement with each, 'Passed' or 'Failed.' I desire to report the list which you may furnish to the National Convention of The National Electric Light Association, which will be held at Niagara Falls August 6th, 7th and 8th. It will, therefore, be desirable to have the list mailed to me by August 1st. Thanking you in advance for the courtesy of your reply, I am very respectfully yours, (Signed) "A. R. FOOTE,

"Chairman of the National Committee on State and Municipal Legislation of The National Electric Light Association."

In response to this request the following reports were received:

Alabama—"I have no knowledge of any bills introduced at the late session of the General Assembly on the subject of electric lights, or other industries."

J. D. BARRON, Secretary of State.

Arkansas—"None introduced."

J. H. SHINER, Chief Clerk, Secretary's Office.

California—"I know of no bills introduced into the Legislature of this State that either 'passed' or 'failed' affecting in any way the electric industry."

H. B. DAVIDSON, Deputy Secretary of State.

Colorado—"H. B., No. 252, making appropriations for the maintenance and support of the State Penitentiary for the years 1889 and 1890, and for other purposes, makes an appropriation for the establishment of an electric light plant within that institution. This is the only bill affecting the matter that I recollect."

JAMES RICE, Secretary of State.

Connecticut—R. I. Walsh, Secretary of State, sends a pamphlet: "Public Acts of the State of Connecticut, passed January session, 1889."

But one act makes any reference to electric lighting. S. B. No. 4, Chapter 9, page 5, An Act relating to Attachments and Judgment Liens.

Delaware—"'An Act was passed taxing Telegraph Companies.' 'An Act was passed granting a charter to charter a company to lay wires under ground for a telegraph line in upper part of State.' 'A bill was introduced to compel electric companies and telegraph companies to put wires under ground in Wilmington.'—Defeated."

JOHN P. SAULSBURY, Secretary of State.

District of Columbia—(No report requested.)

Florida.

Georgia.

Illinois—"'H. B. No. 311. A bill for an Act to authorize cities, incorporated towns and villages, to construct gas and electric works.'—Failed to pass. 'H. B. No. 352. A bill for an Act authorizing cities, villages and incorporated towns to fix, establish and regulate rates to be charged, collected or received from electric light companies, for light, heat and power.'—Failed to pass. These are the only bills that I discover that were introduced to the last General Assembly of this State." I. N. PIERSON, Secretary of State.

Indiana.

Iowa.

Kansas—"I have no knowledge of any bills being introduced during the last session of our Legislature relating to the electric industry."

WM. HIGGINS, Secretary of State.

Kentucky.

Louisiana.

Maine—"There were no bills passed by the last Legislature affecting the electric industry. A few charters of electric light companies was the extent of legislation in that direction." ORAMANDAL SMITH, Secretary of State.

Maryland.

Massachusetts.

Michigan—"In compliance with your request, I have examined the list of bills introduced during the recent session of the Legislature, and find but one bill on the subject—'A Bill to authorize the formation of lighting, heating and power companies.'—Failed to pass."

GILBERT R. OSMUN, Secretary of State.

Minnesota.

Mississippi.

Missouri—"I enclose herewith, copy of section, No. 952, of the law on corporation, which is the only legislation passed by our last General Assembly, affecting the electric industry. The same power is extended to all cities under their different classes." A. A. LESUEUR, Secretary of State.

NOTE:—This is an Act relating to Authority of Municipality to contract with an incorporated company, for lighting by Gas or Electricity, or supply of Water. Contracts may be made for 20 years.

Montana—(No report requested.)

Nebraska—"'H. B. No. 75. An Act authorizing any city of the second class in this State to establish, maintain, operate and control, a system of electric lights, and to fix rates of charges for the use of lights, and to provide for the collection of such charges.' Passed March 30th, 1889. This is all."

GILBERT L. LAWS, Secretary of State.

Nevada—"But two electric bills were introduced during the last session of

our Legislature. Both passed as follows: 'An Act to authorize the Board of State Prison Commissioners, to erect Electric Lights on the State Prison grounds.' 'An Act to authorize the lighting of the State Capitol Building and Grounds by Electricity.'" JOHN M. DORMER, Secretary of State.

New Hampshire—"Our Legislature for this term is still in session. I am not aware of any actual or proposed legislation touching the electric industry." A. B. THOMPSON, Secretary of State.

New Jersey—"I hand you by this mail, a copy, in pamphlet form, of the laws *enacted* by the Legislature of this State at its late session. It will be impracticable for me to furnish you with a list of bills *introduced* at the last session which affected the electric industry."

HENRY C. KELSEY, Secretary of State.

NOTE—In this pamphlet, the following Acts were printed: "An Act requiring Cable Railroad Companies, Electric Railroad Companies and Horse Railroad Companies, to make annual returns to the State Board of Assessors.—Chapter 208, page 96." "An Act concerning cities of this State, and to divide for properly and sufficiently lighting the streets and public places thereof.—Chapter 297, page 137."

New York.

North Carolina—Wm. L. Saunders, Secretary of State, sent a pamphlet of "Captions of the Acts and Resolutions of the General Assembly, passed at the session of 1889, with a synopsis of their contents."

NOTE.—In this pamphlet there are printed seven Acts incorporating companies, or extending the power of incorporated companies, for the purpose of making use of electric service. Also "Act 149, page 18. An Act to empower Gas Companies to supply electricity for lighting and power." "Resolution No. 18, page 82. Resolution in relation to the use of Electric Lights to be put in the Senate Chamber and Hall of House of Representatives."

North Dakota—"There were no laws introduced at our last session of the Legislature, affecting in any way the electric industry."

L. B. RICHARDSON, Secretary.

Ohio.

Oregon—"No Legislation was offered during the last session affecting the electric industry." GEORGE W. MCBRIDE, Secretary of State.

Pennsylvania—Charles W. Stone, Secretary of the Commonwealth, sent a printed copy, entitled "No. 153. An Act, to amend an Act, entitled 'An Act to provide for the incorporation and regulation of certain incorporations,' approved the 29th day of April, Anno Domini, 1874, providing for the

further incorporation and regulation of electric light, heat and power companies."

Rhode Island—" None had." SAMUEL H. CROSS, Secretary of State.

South Carolina.

South Dakota—(No report requested.)

Tennessee.

Texas—"No bill relating to the electric industry was passed at the last session of the Legislature of this State."

J. M. MOORE, Secretary of State.

Vermont.

Virginia.

West Virginia—" 'S. B., No. 102. A Bill authorizing the City of Wheeling to generate, distribute, supply and use electricity and gas.'—Did not pass."

HENRY S. WALKER, Secretary of State.

Wisconsin—"I hand you herewith printed copy of laws, passed during session of last Legislature of this State, relating to electric lighting. The enclosed were the only bills introduced."

ERNST G. TIMME, Secretary of State.

NOTE—The enclosures were: "No. 383. S. Chapter 282. An Act to provide for increasing the facilities of the Department of Mechanic Arts of the State University, and to establish courses in railway and electrical engineering there, and making an appropriation therefor." "No. 293. S. Chapter 375. An Act relating to Electric Light Companies. To provide by suitable insulation, return wires or other means, against injury to persons or property, by leakage, escape or induction, of any and every current of electricity."

Washington—(No report requested.)

Number of States reporting	23
" of States making no report	16
" of States from which no report was requested	4
Total	43

In this connection, I wish to acknowledge the receipt of copies of bills from S. A. Duncan, of Pittsburgh; John B. Garden, of Wheeling; F. A. Gilbert, of Boston; B. E. Sunny, of Chicago; and Ferdinand A. Wyman, of Boston.

After reading the first portion of the paper, Mr. Foote said: The Committee held a meeting yesterday morning, and, as a result of this deliberation, submit the following as a plan of work.

(Signed) A. R. FOOTE, Chairman.

The following are the forms referred to in Mr. Foote's report:

(C. 2.)

PROPOSED MEMBERS OF THE COMMITTEE ON

STATE AND MUNICIPAL LEGISLATION.

A. R. FOOTE, CINCINNATI, O., CHAIRMAN.

1. ✓ Alabama—Wm. Gesner, Montgomery.
2. ✓ Arkansas—Dean Adams, Little Rock.

Printed. 3. California—Geo. H. Roe, San Francisco, 227 Stephenson St.

4. Colorado—C. H. Smith, Denver.

Printed. 5. Connecticut—J. C. English, Bridgeport.

6. ✓ Delaware—Mr. Trump, Wilmington.
7. Florida—G. Stuart Smith, St. Augustine.
8. ✓ Georgia—Judge H. E. W. Palmer, Atlanta.
9. ✓ Illinois—A. L. Ide, Springfield.
10. ✓ Indiana—J. B. Caren, Indianapolis.

Printed. 11. Iowa—Thomas Officer, Council Bluffs.

Printed. 12. Kansas—M. Beebe, Hutchinson.

13. ✓ Kentucky—A. H. Barret, Louisville.
14. ✓ Louisiana—M. J. Hart, New Orleans.
15. ✓ Maine—Geo. Westcott, Portland.

Printed. 16. ✓ Maryland—Arthur J. Steuart, Baltimore, 213 East German Street.

17. ✓ Massachusetts—F. A. Gilbert, Boston, 17 State Street.

Printed. 18. Michigan—J. E. Lockwood, Detroit.

Printed. 19. Minnesota—S. S. Leonard, Minneapolis.

20. Mississippi.
21. ✓ Missouri—J. A. Corby, St. Joseph.
22. ✓ Nebraska—Rigan, Omaha.
23. Nevada.
24. ✓ New Hampshire—Alonzo Elliott, Manchester.

Printed. 25. New Jersey—Moore, Plainfield.

Printed. 26. New York—E. A. Maher, Albany.

27. North Carolina—D. A. Tompkins, Charlotte.

Printed. 28. Ohio—A. R. Foote, Cincinnati.

29. Oregon.

Printed. 30. Pennsylvania—A. J. De Camp, Philadelphia, 123 South 11th Street.

Printed. 31. Rhode Island—M. J. Perry, Providence.

32. ✓ South Carolina—Geo. B. Edwards, Charleston.

Printed. 33. Tennessee—Robert L. Morris, Nashville.

34. ✓ Texas—David Hall, Galveston.

Printed. 35. Vermont—J. M. Francisco, Rutland.

36. ✓ Virginia—Maurice B. Flynn, Richmond.

37. West Virginia.
38. ✓ Wisconsin—Henry C. Payne, Milwaukee.

Printed. 39. Washington, D. C.—Geo. Truesdale.

NOTE.—Names marked "Printed" are announced as members of the Committee, in the official proceedings of the Association.

Where no name is given, please suggest one.

When the full address of any person mentioned is known to you, please write it on the sheet you return.

Two copies of this list will be sent to person nominated as a member of the Committee. After receiving their reply, I will send out a new list, showing those who have accepted, and what States are vacant.

Respectfully,

A. R. FOOTE, Chairman.

A. R. FOOTE, Chairman,
Cincinnati, Ohio.

.... *1889.*

Dear Sir: I hereby accept the appointment tendered me by the Officers and Executive Committee of the National Electric Light Association as a member of the National Committee, for my State, on State and Municipal Legislation.

Respectfully,

Signature ....

Address ....

Number and Street ....

NOTE.—Please state below with what electrical interest and in what capacity you are identified.

If any of the names on this list are those of persons not intimately identified with operating companies, I think they should be dropped and other names substituted for them. A. R. FOOTE.

(C. 3.)

PROPOSED PLAN OF WORK OF THE NATIONAL COMMITTEE OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION ON STATE AND MUNICIPAL LEGISLATION.

CINCINNATI, April 25, 1889.

NOTE.—You are requested to return one copy of this paper on or before May 6, 1889, with your suggestions. A. R. FOOTE.

1. An examination will be made of the laws in each State to see in what particulars, if any, the electrical industry can be benefited by securing any practicable change in such laws.

2. All bills, affecting in any way the interests of the electrical industry, that were introduced at the last session of the Legislature of any State, but which did not become laws, will be examined to ascertain the *tendency of* legislation and to see if it is desirable that they should be passed.

3. Whenever any legislation is desired in any State, or if legislation is proposed that is not desired, copies of the bill proposed will be furnished to the chairman of the committee. He will then furnish the member of the committee for that State such data, arguments and citations as he may be able to provide, to enable said member to place information in the hands of proper persons through whom the desired result may be secured.

4. All work done in one State will be kept in printed form, so that it can be used at once in any other State. The work will thus become accumulative, and of such a thorough character as to be practically irresistible.

5. No legislative measure or economic principle will be advocated in any manner in the name of the committee without the approval of a majority of the whole number of its members, nor will the committee undertake to secure legislation in any State without the approval of the member for that State, and then only when sufficient preparation has been made to render success a reasonable certainty.

6. Each member of the committee will recommend to the chairman an attorney for his State, who will receive and preserve for reference copies of all documents published or approved by the committee, to the end that if at any time it becomes necessary to employ counsel in that State, or if any special interest requires such service, said attorney will have the desired information, and can represent the committee, or such special interest as may wish to employ him, and have at his command much of the data necessary to familiarize himself with the subject.

7. All other considerations being equal, an attorney residing at the capital of the State will be preferable.

8. The funds of the Association are not to be used for any of the expenses of this committee in any manner whatever.

(C. 4.)

PROPOSED LETTER,

Tendering the Appointment to Persons who are Members of the Association, as a Member for his State on the National Committee of the

NATIONAL ELECTRIC LIGHT ASSOCIATION ON STATE AND MUNICIPAL LEGISLATION.

Note—You are requested to return one copy of this letter on or before May 6, 1889, with your suggestions. The letter will be sent out in printed form, with all the matter omitted that is printed above the date on this sheet.

A. R. Foote.

DEAR SIR: CINCINNATI, April, 25, 1889.

1. On the recommendation of a majority of the officers and members of the Executive Committee of the Association, I have the pleasure of inviting you to serve as a member for your State on the National Committee of The National Electric Light Association on State and Municipal Legislation.

2. This recommendation has been made, and the invitation is given you, in the belief that your co-operation will be very valuable to the Association, and that, when you have examined into the matter, you will at once accept the appointment.

3. The inclosed list will show you to whom a similar invitation will be extended at this time. The effort to secure an influential and active member for each State will be continued until the entire list is completed.

4. You will understand the impractibility of marking out a "hard and fast" line of work for the Committee. The inclosed "outline" is considered sufficiently definite for the present. The policy of the Committee will be to keep a close watch over the laws and all proposed legislation, and to prepare itself with such data as will enable it to render effective service *at the proper time* in any State where action is needed.

5. Since the reason for organization is based on the fact that the many can easily accomplish that which is impossible to an isolated *one*, it is very desirable that every company in your State, interested in any way in the welfare of the electric industry, shall be represented by membership in The National Electric Light Association. The work proposed to be done is but a small part, important as it may be in itself, of the benefits that may be obtained by local companies from such a membership. It is true of this Association, as it is of all others, that its value to its members is enhanced in ratio to the number who sustain it. The better it is endowed, the better value it can give for the time and money spent in its support.

6. With the object of securing a membership from all local companies in your State, it may be thought well to at some time advise them of the proposed work of this Committee, to induce them to become members.

7. I trust you will examine these papers carefully, believing that if you do so, you will not hesitate to accept the appointment hereby tendered you, and to co-operate with the Committee in such ways as may be thought desirable.

Yours respectfully, A. R. FOOTE, Chairman.

(C. 5.)

PROPOSED LETTER,

Tendering the Appointment to Persons who are NOT Members of the Association, as a Member for his State, on the NATIONAL COMMITTEE of The

NATIONAL ELECTRIC LIGHT ASSOCIATION OF STATE AND MUNICIPAL LEGISLATION.

NOTE.—You are requested to return one copy of this letter on or before May 6th, 1889, with your suggestions. The letter will be sent out in printed form, with all the matter omitted that is printed above the date on this sheet. A. R. FOOTE.

CINCINNATI, April 25th, 1889.

DEAR SIR:

1. Although you are not a member of the National Electric Light Association, on the recommendation of a majority of the officers and members of the Executive Committee of the Association, I have the pleasure of inviting you to serve as a member for your State on the National Committee of the National Electric Light Association on State and Municipal Legislation.

2. This recommendation has been made, and the invitation is given you in the belief that your co-operation will be very valuable to the Association, and that, when you have examined into the matter, you will see that the benefits you can derive from a membership in the Association are of such a character that you will at once fill out the inclosed application and qualify yourself to serve on the Committee by becoming a member of the Association.

3. The inclosed list will show you to whom a similar invitation will be extended at this time. The effort to secure an influential and active member for each State will be continued until the entire list is completed.

4. You will understand the impractibility of marking out a "hard and fast" line of work for the Committee. The inclosed "outline" is considered sufficiently definite for the present. The policy of the Committee will be to keep a close watch over the laws and all proposed legislation, and to prepare itself with such data as will enable it to render effective service *at the proper time* in any State where action is needed.

5. Since the reason for organization is based on the fact that the many can easily accomplish that which is impossible to an isolated *one*, it is very desirable that every company in your State, interested in any way in the welfare of the electric industry, shall be represented by membership in The National Electric Light Association. The work proposed to be done is but a small part, important as it may be in itself, of the benefits that may be obtained by local companies from such a membership. It is true of this Association, as it is of all others, that its value to its members is enhanced in ratio to the number who sustain it. The better it is endowed, the better value it can give for the time and money spent in its support.

6. With the object of securing a membership from all local companies in your State, it may be thought well to at some time advise them of the proposed work of this Committee to induce them to become members.

7. I trust you will examine these papers carefully, believing that if you do so, you will not hesitate to accept the appointment hereby tendered you, and to co-operate with the Committee in such ways as may be thought desirable.

Yours respectfully,

A. R. FOOTE, Chairman.

(C. 11.)

ENCOURAGEMENT—APPRECIATION

FOR THE

NATIONAL COMMITTEE ON STATE AND MUNICIPAL LEGISLATION.

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1. Every isolated worker is susceptible to the influence of words and deeds of encouragement and application, by those far removed from him. When, in their own State, those interested in any manner in the electric industry are called upon to grapple with the problems of legislation at the State Capital or in municipal council, they are sure to place a high estimate on assistance rendered them by those who are far removed and disinterested. The fact that those giving assistance *are* far removed from, and *are* disinterested in the local issue, gives great strength to their presentation of the subject.

2. Upon these plain principles, governing the weighing of evidence and influence in the human mind, the work of the National Committee on State and Municipal Legislation has been planned. The duties of a member of the Committee are merely nominal, while there is no legislative action in his State. As soon as the electric industry becomes involved in such action, however, his work begins. It is not increased, but lessened, by reason of his position as a member of the Committee for his State. Look after his own interests he must, therefore, to be assisted in this, by the experience of others in 41 States, is to have his work made easy and certain. The short of the proposition is, *for the influence, prestige and experience gained by you in your own State, the National Committee will give you, in even exchange, the influence, prestige and experience gained in* 41 *States.* Not a bad bargain for the one member in each State, is it?

3. The advantages of the "Plan of Work" have been seen so clearly, and are so appreciated, I am able to state that on the first call, 19 nominees accepted the appointment as a member of the Committee for their respective States. Of this number, *eight have become members of, or have reunited with, The National Electric Light Association, in order to qualify themselves to serve on the Committee.* A committee composed of those who accept their appointment under such circumstances, can be depended upon to do good work.

4. To show the need of such work as this Committee is designed to do, and the appreciation its assistance is sure to find, I give two quotations from letters received:

"WHEELING, W. Va., May 28, 1889.

"DEAR SIR:

"Inclosed please find my acceptance of appointment on the National Committee on State and Municipal Legislation for the State of West Vir-

ginia. You will also find herewith copy of a bill presented to the Legislature at its last session, by the City of Wheeling, which would have been passed but for timely action upon our part. We may be compelled to fight this bill again this Fall, as there will be an extra session of the Legislature. Our city council has passed a resolution asking the Governor to put this bill in his call for the extra session. We have been doing everything possible to induce him to omit it. In case we are not successful, would like to have all the information at hand to assist us in defeating the bill. We had little trouble last session in keeping the bill down, but we were helped considerably by the fight over the United States Senatorship.

"We are pleased to state that the papers read before the Chicago Convention were of great benefit to us in getting up our argument. I have forwarded to New York check and application for membership in The National Electric Light Association. * * * * "Fraternally yours,

"JNO. B. GARDEN,

"Secretary and Treasurer, the Wheeling Electric Co."

NOTE.—The bill referred to above is to give the City of Wheeling, "full power and authority to purchase, erect, build, improve and maintain, any and all buildings, works, plants, pipes, pipe lines, wires, supports and other fixtures, to be used in generating, distributing, controlling, or otherwise using electricity, and the products of any combination or combinations used for producing or generating electricity, and also any building or buildings, works, plants, pipe lines, or other things necessary to be used in transporting and using gas of any sort, whether made from any substance or combination thereof, or otherwise obtained by said city, and to use, generate, distribute and control electricity and gas for light and heat, and for the purpose of furnishing light for the streets, buildings, stores and other places in and about the said city, and also for the purpose of heating furnaces, factories, buildings, houses, engines, cars and conveyances, and of operating engines, cars, motors, and other motive machinery, and for other purposes, for which light, electricity and heat may be used."

If the National Committee had been fully organized and collected the data, how easy it would be to send to West Virginia the arguments used in the Danver's case, in Massachusetts, or *vice versa*. This will serve to illustrate how the work of the Committee may be made effective.

"ST. JOSEPH, MO., May 25, 1889.

"DEAR SIR:

"On my return home I find your favor of May 10, notifying me of my nomination on the Committee on State and Municipal Legislation, of The National Electric Light Association. Inclosed please find my acceptance of the same. * * * I have just returned from our State Capital, where I

succeeded in defeating the bill reducing the rentals on telephones. You can count on my hearty assistance at any and all times.

"Yours very truly,

"JOSEPH A. CORBY,

"Pres., St. Joseph Electric Light and Power Co.; Director, Pacific Mutual Telegraph Co. and Pacific Telegraph Co.; Vice-Pres. and Manager, People's Street Railway and Electric Light and Power Co.; Stockholder, Missouri and Kansas Telephone Co."

5. The general estimate of the work by those interested in electrical subjects, is well expressed by the following editorial notices:

From *Modern Light and Heat*, May 16th:

"We desire to call particular attention to the circulars printed in this issue of our journal, under the title 'National Committee on State and Municipal Legislation, of The National Electric Light Association.' A perusal of the communications will disclose the important nature of the work which the 'National Committee' has undertaken. As is well known, The National Electric Light Association has accomplished a great deal in the direction of harmonizing, unifying and promoting the growth of all electrical matters throughout the country. And now that there is no more important industry in existence, nor one possessing such far-reaching possibilities of expansion in the future, it is of supreme importance that all engaged in this industry should insist in securing right and proper legislation when any such legislative action becomes necessary. To this end was the 'National Committee' appointed at the Chicago Convention, and we cannot too strongly urge every one eligible for membership in the Association, or appointment on this particular Committee, promptly to respond to this invitation, and identify themselves with a movement which is certain to emanate in good to every person engaged in electrical enterprises, whether as workers or investors. The Committee is pursuing a very business-like course in the discharge of its duties and the accomplishing of its ends, and we bespeak for it the attention and co-operation of all."

From the *Electrical Review*, May 25th:

"THE WORK OF THE NATIONAL COMMITTEE BEGUN.

"The National Committee on State and Municipal Legislation, of The National Electric Light Association, of which Mr. A. R. Foote is chairman, is fast taking a shape where it will be felt in the community.

"The difficulties of getting this Committee into shape were by no means inconsiderable, for several reasons. Made up, as it is, of one member from each State in the Union, it has been necessary to carry on all the work by correspondence, which is, of course, a slow and laborious process. What has been still more embarrassing, is the fact that there are several States in which the Association has no member, and the chairman has found himself, in

several cases, obliged to solicit representative men in kindred electrical pursuits to join the Association, that they might serve on the Committee, which even now has not a full complement of members.

"The plan of operation sketched out by the chairman at the February Convention, in Chicago, and still further elaborated in a recent communication (Form C. 7), leads one to believe that if carried out in detail, the work of this Committee will be of much practical use.

"An examination of the laws of each State, and a determination if the electrical industries can be in any way benefited by their change; a study of all legislative bills, to see if it is wise for the electrical fraternity to aid in their passage; a bureau which shall be the repository, and from which may be obtained all data, arguments, citations, etc., touching legislation on electrical industries, is an undertaking not to be entered into lightly nor to be carried into successful operation by any one not skilled in the collection of facts and the sifting of truth from error."

6. It is not alone those interested in the electric industry who have noticed the "Plan of Work" adopted for this Committee, and sensed its importance.

After printing this "Plan of Work" in full, *The Chicago Journal of Commerce* says, editorially, June 5th :

"Printed copies of the above were submitted to the officers and Executive Committee of the Association and with them copies of the letters to be used in inviting the persons nominated to accept the appointment as a member of the Committee.

"Perhaps nothing more definitely indicates the permanency of electricity as a public blessing than does this action of the Association and the foregoing plan of work outlined for the Committee. It shows that State and national legislation and municipal regulation are requisite to define the rights, privileges and powers of electrical corporations and their work, and that electricity has taken its place in the ranks of advancing and useful industries, and is amenable to the people for its encroachments upon public and private interests.

"We believe that electrical progress and invention are yet in their infancy, and that electricity, in all of its forms, will soon supersede many of the older sciences in its relation to the common welfare of the people. Therefore, we are in favor of securing to it every legal advantage and of restraining its undue disregard of law and equity."

7. Last, and most to be valued, are words of appreciation from the senior twin, the gas industry. To have "the electricians' plan" recommended editorially to the American Gas Association, by *The American Gas Light Journal*, June 10th, satisfies all the requirements of an honorable and authoritative endorsement.

The editorial notice is as follows:

"Although we alluded before to Mr. Ramsdell's pronounced and politic remarks respecting the value and efficacy of State gas commissions, in his address before the Western Association, we are again moved to draw atten-

tion to them because of the outcome of the resolution adopted just before the adjournment of the Chicago Convention of the National Electric Light Association. This resolution created a 'National Committee on State and Municipal Legislation' (to consist of one representative from each State and Territory of the Union), and the plan of work set out for the Committee is thus arranged—we reprint this because it seems to us that it would be well worthy of the close attention of the executive management of the American Association. The scheme here outlined looks to us to meet all the objections that were urged in the meeting of the Executive Committee (New York, 1887) of the American Association, when it was decided to report 'that it is inexpedient to take action upon the subject'—*i. e.*, 'Gas Commissions,'—which matter had been referred to the Committee from the Convention of the preceding year. The electricians' plan, however, is: [Here follows a complete copy of the 'plan of work.']

"These rules and regulations are simple enough, and are quite certain to result in benefit for the interest in which they were framed. One fact also becomes more pronounced with each year, and that is the conviction that sooner or later the gas interest will be controlled by special enactment. Would it not be wise, then, that these special enactments should spring from the gas man rather than from the State?"

8. With such evidence, showing that the line of work for the Committee is well planned and that it is needed and appreciated, I hope every person nominated to serve on the Committee will at once accept his appointment. this will enable me to present a completed Committee to the Niagara Convention, and the Convention to start the Committee on its career of useful work.

Respectfully,

A. R. Foote, Chairman.

(C. 7.)

Plan of Work of the
NATIONAL COMMITTEE ON STATE AND MUNICIPAL LEGISLATION
OF
THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

1. An examination will be made of the laws in each State to see in what particulars, if any, the electrical industry can be benefited by securing any practicable change in such laws.

2. All bills, affecting in any way the interests of the electrical industry, that were introduced at the last session of the legislature of any State, but which did not become laws, will be examined to ascertain the *tendency of* legislation and to see if it is desirable that they should be passed.

3. Whenever any legislation is desired in any State, or if legislation is proposed that is not desired, copies of the bill proposed will be furnished to the chairman of the Committee. He will then furnish the member of the Com-

mittee for that State such data, arguments and citations as he may be able to provide, to enable said member to place information in the hands of proper persons through whom the desired result may be secured.

4. All work done in one State will be kept in printed form, so that it can be used at once in any other State. The work will thus become accumulative, and of such a thorough character as to be practically irresistible.

5. No legislative measure or economic principle will be advocated in any manner in the name of the Committee without the approval of a majority of the whole number of its members, nor will the Committee undertake to secure legislation in any State without the approval of the member for that State, and then only when sufficient preparation has been made to render success a reasonable certainty.

6. Each member of the Committee will recommend to the chairman an attorney for his State, who will receive and preserve for reference, copies of all documents published or approved by the Committee, to the end that if at any time it becomes necessary to employ counsel in that State, or if any special interest requires such service, said attorney will have the desired information and can represent the Committee, or such special interest as may wish to employ him, and have at his command much of the data necessary to familiarize himself with the subject.

7. All other considerations being equal, an attorney residing at the capital of the State will be preferable.

8. The funds of the Association are not to be used for any of the expenses of this Committee in any manner whatever.

A. R. Foote, Chairman.

(C. 8.)

Cincinnati, May, 10, 1889.

Dear Sir:

1. On the recommendation of a majority of the officers and members of the Executive Committee of the Association, I have the pleasure of inviting you to serve as a member for your State, on the National Committee on State and Municipal Legislation of The National Electric Light Association.

2. This recommendation has been made, and the invitation is given you, in the belief that your co-operation will be very valuable to the Association, and that, when you have examined into the matter, you will at once accept the appointment.

3. The inclosed list will show you to whom a similar invitation will be extended at this time. The effort to secure an influential and active member for each State will be continued until the entire list is completed.

4. You will understand the impractibility of marking out a "hard and fast" line of work for the Committee. The inclosed "outline" is considered sufficiently definite for the present. The policy of the Committee will be to

keep a close watch over the laws and all proposed legislation, and to prepare itself with data as will enable it to render effective service *at the proper time* in any State where action is needed.

5. Since the reason for organization is based on the fact that the many can easily accomplish that which is impossible to an isolated *one*, it is very desirable that every company in your State, interested in any way in the welfare of the electric industry, shall be represented by membership in The National Electric Light Association. The work proposed to be done by this Committee is but a small part, important as it may be in itself, of the benefits that may be obtained by local companies from such a membership. It is true of this Association, as it is of all others, that its value to its members is enhanced in ratio to the number who sustain it. The better it is endowed, the better value it can give for the time and money spent in its support.

6. With the object of securing a membership in the Association from all local companies in your State, it may be thought well to at some time advise them of the proposed work of this Committee, to induce them to become members.

7. I trust you will examine these papers carefully, believing that if you do so, you will not hesitate to accept the appointment hereby tendered you, and to co-operate with the Committee in such ways as may be thought desirable.

Please oblige me with your reply on or before June 15, 1889.

A. R. Foote, Chairman.

(C. 9.)

Cincinnati, May 10, 1889.

Dear Sir:

1. Although you are not a member of The National Electric Light Association, on the recommendation of a majority of its officers and members of the Executive Committee of the Association, I have the pleasure of inviting you to serve as a member for your State on the National Committee on State and Municipal Legislation of The National Electric Light Association.

2. This recommendation has been made, and the invitation is given you, in the belief that your co-operation will be very valuable to the Association, and that, when you have examined into the matter, you will see that the benefits you can derive from a membership in the Association are of such a character that you will at once fill out the inclosed application and qualify yourself to serve on the Committee by becoming a member of the Association.

3. The inclosed list will show you to whom a similar invitation will be extended at this time. The effort to secure an influential and active member for each State will be continued until the entire list is completed.

4. You will understand the impractibility of marking out a "hard and fast" line of work for the Committee. The inclosed "outline" is considered

sufficiently definite for the present. The policy of the Committee will be to keep a close watch over the laws and all proposed legislation, and to prepare itself with such data as will enable it to render effective service *at the proper time* in any State where action is needed.

5. Since the reason for organization is based on the fact that the many can easily accomplish that which is impossible to an isolated *one*, it is very desirable that every company in your State, interested in any way in the welfare of the electric industry, shall be represented by membership in The National Electric Light Association. The work proposed to be done by this Committee is but a small part, important as it may be in itself, of the benefits that may be obtained by local companies from such a membership. It is true of this Association, as it is of all others, that its value to its members is enhanced in ratio to the number who sustain it. The better it is endowed, the better value it can give for the time and money spent in its support.

6. With the object of securing a membership in the Association from all local companies in your State, it may be thought well to at some time advise them of the proposed work of this Committee, to induce them to become members.

7. I trust you will examine these papers carefully, believing that if you do so, you will not hesitate to accept the appointment hereby tendered you, and to co-operate with the Committee in such ways as may be thought desirable.

Please oblige me with your reply on or before June 15, 1889.

A. R. FOOTE, Chairman.

CINCINNATI, July 24, 1889.

DEAR SIR:

1. These inclosures will fully explain themselves to you.

2. It is very desirable that the list of members of this Committee be made as complete as possible before the meeting of the Convention in August next. Any name that you may suggest to fill a vacancy will be at once addressed on the subject, provided some other person for the same State has not been addressed before your nomination reaches me.

3. I ask you to consider the organization of the Committee, with the view of making such suggestions as will tend to secure its continuity and render it a practical, efficient, working body.

4. I also ask your special attention to the "Plan of Work," and request you to make a note of such changes in it as you think will be beneficial.

5. If each member will favor the Committee with his suggestions, the Committee ought to be able to present a well considered "Plan of Organization and Work" to the Convention for its adoption. One that will be adopted by a unanimous vote of the Convention, and will afterward be the law of the Committee. In case you cannot present your suggestions in person, if forwarded to me, they will be presented to the Committee in your behalf.

6. Wishing the Committee to have an early opportunity to meet, make one

another's acquaintance, and have ample time in which to prepare a report for presentation to the Convention on its second day's session, I request you to attend a meeting of the Committee, on Tuesday evening, August 6th, at 7 o'clock, to be held at the International Hotel, Niagara Falls. Notice of the room in which the meeting will be held will be posted in the office of the hotel.

7. That I may know who to expect to be in attendance, I will thank you to signify your intention of being present by returning me the inclosed card.

8. I shall write a report of the work done in organizing the Committee, from the date of the adoption of the resolution creating it, to the date of its first meeting at Niagara Falls. To this will be added the action of the Committee at its first meeting; the whole to be submitted to the Convention as the Report of the Committee, that it may become a part of the records of the Association.

9. Hoping that all vacancies may be filled by the time the Committee is required to report to the Convention, and that you may be able to enjoy the satisfaction of being present at the first meeting of the Committee.

A. R. FOOTE, Chairman.

In conclusion, Mr. Foote said: That plan of work is submitted to the Convention for its action. In addition to that, the Committee adopted the resolutions made by Dr. Moses, read yesterday, on the subject of electrical execution. That subject coming up before the report of the Committee, I thought it best to hand the resolutions to Dr. Moses, that they might be brought in and acted upon in connection with his address. This, gentlemen, is the Report of the Committee.

THE PRESIDENT: You have heard the Report of the Committee. If there is no objection, the report will be received, filed and spread upon the minutes of the Association. The Chair hears no objection. It is so ordered.

MR. H. W. POPE: Mr. Chairman, I think this matter of the Legislative Committee should not be passed over so lightly. It is to us in New Jersey a most important Committee. That is to say, every Winter we meet with legislative strikes. Last Winter it was with difficulty that we overcame very adverse legislation, and we had in mind the forming of a State legislation for the purpose of carrying on that work after we appreciated that every year we would be in worse circumstances. Now, we have incurred some expense. I would like to ask the President if the finances of the Association would admit of our making any expenditures at all in connection with this matter. It is almost

impossible for us to do it now, as I understand it. We have got to have an attorney in these different States and must go to some expense, else the efforts of this Committee will not amount to anything.

MR. A. J. DE CAMP: Mr. Chairman; on that point it has been manifest to the Committee, of which I have the honor to be a member, that a general committee is necessary in order that one State should get the benefit of what is done, or known to be done, in another State. The organization of State committees has suggested itself as being the best way of accomplishing that result. But in order to get that information and have it disseminated over the country so that the State of Ohio can have the advantage of the information, and have it in a shape in which they can use it, we have got to have a general committee, because we are all aware that the legislation in one State is very largely shaped upon what is done in another State. There is no legislature or committee of legislature which would probably be able to deal alone with the question. The State committees are the parties to shape that legislation in their own State, and they only can do it. I do not see that this Committee can make any progress in that direction, and, in answer to Mr. Pope, that thing has already been blocked out by this Committee, and it is a pretty big work, and whether it will be gotten into shape by the next meeting is a question. It is too big a work; it will probably take a year or two to get that into right good shape, but I believe it will be very effective when it is put through.

MR. H. W. POPE: I feel very much in the matter, because we will not meet again probably until the legislatures meet in the various States, especially in our State, and we feel the necessity of getting right at work in the matter. We are close to New York, and feel the effect of all this New York legislation, and there is a continual cry there against overhead wires. The strong companies take the opportunities to oppress us all the while.

MR. BENJAMIN RHODES: Mr. Chairman, the question has been asked here about the finances of the Association, and whether they would permit the appropriation of a certain amount of funds for the purpose of this Committee. I would like to say, to

anticipate in part the report of the Committee, which will be presented this afternoon, that the finances of the Association are in much better shape than they were six months ago. When this Executive Committee came into power, there was a large indebtedness—comparatively large for this Association. During these six months the whole indebtedness has been paid, and the Association is now out of debt, with a balance of cash in the Treasurer's hands. There will be to pay during the next few days, a certain amount for the expenses of this Convention and the printing of these proceedings, which will cost much more than the proceedings of any other Convention that has ever been held, because they will cover more pages. The Association is financially in a solid condition at present, but the treasury is not in such shape that it will permit any large drafts, and I sincerely hope that no resolution appropriating funds to any purpose whatever will be passed at this Convention. And, if any such appropriation is contemplated, that it will not be made, without first being referred to the Executive Committee, to the Treasurer, or to the Finance Committee, which is a sub-committee of that Executive Committee, for their consideration and report. It seems to me necessary that the finances of the Association should be kept in good condition, and not suffered to be relegated to the position in which they were six months ago.

MR. A. J. DE CAMP: Mr. Chairman, it has been the practice of this Association to make an appropriation for everything outside of its general committee. Now, if Mr. Pope forms the State Association, and I propose to make that effort in the State of Pennsylvania, that Committee will have to do its own work. The general committee can only help them by furnishing such information as they have been able to collect from other States, and that is, the Committee to bear the expense of that particular legislation. I do not think it will be a very burdensome expense; at least that Committee can do its work very much more cheaply than the general committee can do it. After that Committee gets to work, the legitimate current expenses of the general committee will be about all that this Association will be able to appropriate—if they are able to appropriate anything. It may occur to some that if these State Associations are formed and they do their own work and pay their own expenses, they

have no interest in the general committee—but they have. The compensation that they will get from that will be a very considerable one. In this shape, the State Committee could accomplish more in one day than could otherwise be accomplished in six months, because the general committee will have it in just such shape as they want.

Mr. S. S. Leonard: Mr. President, I would like to ask Mr. Foote if there has not already been some expense incurred in the work of this Committee?

Mr. A. R. Foote: In answer to that question I will have to say that there has been some expense incurred. I incurred it entirely on my own responsibility, as I have never had authority to spend any of the money of the Association. The amount of money I have paid for printing for the committee is about $95, for which I have shown a receipted bill to the members of the Committee.

Mr. S. S. Leonard: Then it seems to me, Mr. President, that the least the Convention could do would be to re-imburse Mr. Foote. If there are no funds to make any further appropriations, it hardly seems the proper thing to ask Mr. Foote to carry on this work and pay out of his own pocket for something that we expect to reap the benefit from.

Mr. Benjamin Rhodes: Mr. Chairman, possibly my statement has been a little misunderstood. I suggested, and I am sure I represent the opinion of every member of the Executive Committee on that point, that no appropriation should be made in this Convention in session assembled without being referred to the Executive Committee. I understand that this Committee has been at some expense for printing. I do not think that the account should be thrown out, but I do think that it should be referred to the Executive Committee for their report, simply because it will furnish a precedent. If these accounts are referred to the Executive Committee, I have not the slightest doubt that the chairman of the Executive Committee would pay such an account as that, but I believe the proper course is to have it so referred, or refer it to the Treasurer or Finance Committee, to know whether the treasury will support it.

Mr. A. J. De Camp: Mr. Chairman, I would move that the

chairman of that Committee render his accounts, and that the same be referred to the Executive Committee.

Mr. Benjamin Rhodes seconded the motion.

Mr. E. T. Lynch, Jr.: Mr. Chairman, I think this is straying away from the point we started out on. I think the most important question is not whether we will go to any expense in providing legal talent in the various States or for the main committee, nor whether we shall pay Mr. Foote's bill or not, but the important question is, what shall we pay in the future? I think Mr. Foote should submit to the Association some of the items showing the expenses.

Mr. Fred. H. Whipple: Perhaps I can assist the Association in this matter. I am connected with a street railway company in the West which has reports of all the laws upon the statute book in every State, and I am willing to offer that to the Association free of cost. Within a very short period of time I will be able to present to the Association the complete law upon the statute books of every State in the Union. I have the work very nearly done now, and at an expenditure of something like $2,000. It will certainly cost the Association $2,000 to get that information.

The President: The question is on Mr. De Camp's motion to refer the account to the Executive Committee.

(This motion being duly seconded, was put by the President and carried.)

Mr. E. T. Lynch, Jr.: I move that the chairman of the Committee be requested to submit to the Association, or to members of the Executive Committee, a statement giving in detail the expenses that he thinks this Committee would incur in the future.

The President: I might say in this connection, gentlemen, that this Committee has done a great deal of work at considerable expense, all of which we appreciate. But that this work has been added upon by Mr. Foote and his colleagues, actuated by motives of good for the Association, and with the distinct and clear understanding that the work should be done without expense to the Association. If there is no further discussion on this topic, it will now be passed.

Mr. J. F. Morrison: One remark. Mr. Foote does not ask

you for any pay. The suggestion of Mr. Lynch covers a ground that Mr. Foote cannot answer. He is engaged in a work that covers a great deal of ground. He could not make an estimate of the expense of such work. He has not asked you for anything. He has made no proposition to present a bill to the Association. They have asked him to present a bill of the expenses to be referred to the Executive Committee, and I have no doubt that he will do it. The Association has never been niggardly in my experience. They have paid claims of members from time to time without any question. I think at this time this business is entirely out of order.

MR. E. T. LYNCH, JR.: I think that I have been misunderstood. It was only my desire to facilitate the movements of Mr. Foote's Committee. I will withdraw my motion.

THE PRESIDENT: Is Mr. Rhodes ready to report for the Executive Committee?—We will first hear from the Secretary a communication from Mr. Steuart, chairman of the Committee on Patent Legislation.

THE SECRETARY: Mr. President and Gentlemen, I have the following letter:

ALLAN V. GARRATT, ESQ., BALTIMORE, August 5th, 1889.
Niagara Falls, New York.

DEAR SIR:

I have your favor of some days since, and am sorry to say I will be unable to be with you at the Convention at Niagara. My partner is away, and I am so busy that I will be unable to leave.

Please say to the Convention for me, that the plans of the Legal Committee are all in shape to begin operations upon the 51st Congress as soon as it convenes. Judge Culberson, who was the chairman of the Judiciary Committee of the last session, I am told, will be upon the same committee during the coming Winter, and out of courtesy to him our Bill will be taken up among the very first acted upon, and his previous report adopted. I hope we may be able to induce him and the other members of the committee to recommend the passage of the Bill as it was originally filed providing for five judges instead of three, as recommended by the committee report of last year. There is every reason to suppose that we will have little trouble in passing the Bill in the 51st Congress, and if we succeed, The National Electric Light Association may congratulate itself upon having achieved a very great reform in the patent system of the United States. The work of this committee during the next six months to have my best efforts, and I feel very sanguine of success.

Very truly yours,

ARTHUR STEUART, Chairman.

This communication was received and ordered to be spread upon the minutes.

THE PRESIDENT: We will now hear from Mr. C. C. Haskins, city electrician of Chicago.

Mr. Haskins then read the following paper, entitled, Dynamo Room Accessories, Intensity, Potential and Resistance Measurements.

DYNAMO ROOM ACCESSORIES FOR INTENSITY, POTENTIAL AND RESISTANCE MEASUREMENTS.

BY C. C. HASKINS.

The investigator who expects to find a steam plant running without a water and a steam gauge at the present day will reckon without his host, and in very many instances he will find also a tell-tale pressure gauge in the office of the manager, who can turn at any moment without moving from his desk, and see as well as if he took a run over to the engine room, what pressure the boiler is carrying. It was not so in the days of Boulton and Watt, but the fact that those worthy representatives of the past were without such modern appliances has not kept these from becoming honored occupants of the engine room of to-day. Progress is near akin to that mother of invention, of whom we so often hear, and progress just now calls for more and better appliances for the improvements of our methods of producing and the handling of that boundless and wonderful energy which we call electricity. We have advanced far enough to see that economy in production is essential, and we are now learning that having once developed that energy, the old and homely adage of Franklin, "Waste not, want not," is as applicable to electric economy as to matters of merchandising or the cultivation of the soil.

While the inventor is striving, and with reasonable success, to lessen the fuel expense, and the wear and tear is being looked after by the constructor, we may ask is the operator keeping his end of the burden level by a proper attention to the means within his reach for aiding in the general economy? That the inventor has assiduously labored at his part of the task is abundantly shown by the records. There are meters and meters. Ingenious meters, and almost judicious meters. No sooner was it seen that a necessity had arisen for something by which to measure currents, than men of inventive ability and men without, nearly tumbled over each other in their haste to reach the front and present their various claims. A look at a few of these may not be uninteresting. I have not endeavored to classify the following, nor do I claim to have gathered all there are in existence. To many of these there are several claimants, and I have quite generally adopted the rule of mentioning no names, a safe method, perhaps, of keeping out of the muddle which sometimes arises from a trifle of jealousy, and leaving the ownership to be decided by others. My object is to cite the apparatus, not the inventor.

Gravier, in 1880, suggested that with a given carbon, the current consumed would bear a direct ratio to the amount of light given. He supported his statement by mathematical calculations, and comparative tests by other methods. This was ampere measuring by photometry. In the same year Marcel Deprez and Siemens and Halske brought out nearly parallel inventions. In the former, a long coil is placed parallel to and between the legs of a horizontal horseshoe magnet, extending from the neutral point to the poles. This coil is so adjusted as to revolve like a shaft at right angles to its length, being delicately supported at either end. An index attached to the shaft is made to act as a scale beam, and a sliding weight restores it to zero. This form of galvanometric weighing differed principally from Siemens and Halske's invention in that the latter was a vertical arrangement of coil and magnet. Becquerel and Joule had also accomplished much the same result before then. Hopkinson's voltmeter had two parallel wires, through one of which the current was passed. To one of these an index was attached, the other being part of a graduated arc. The dilitation of the wires by normal heat moving both index and scale in the same direction kept the indicator at zero, so that when a current traversed the second wire there was no error due to normal temperature to be corrected. Heat in this case was the measure of pressure. Siemens and Halske, among other inventions, exhibited one of a still different form. In this, there is a combination of solenoids and clockwork, with a registering disk.

A very radical departure was made by an English inventor, who is well known in electric lighting. In the system which he patented, a lever at one extremity terminated in a solenoid core, while at the other extremity of the lever was a plunger valve. When the current passed through the coils of the solenoid, the core was sucked in, the valve was opened, and water flowed out more or less rapidly in proportion to the size of the opening, which at last,

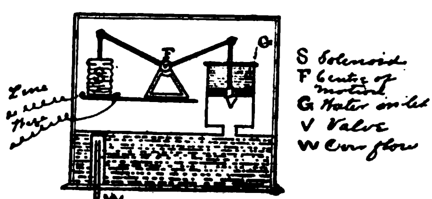


Fig 1

of course, was governed by the suck of the solenoid, a sort of temperance ampere meter. An automatic syphon emptied the reservoir and then it filled. The quantity of water was assumed to be directly proportioned to the flow of current. (See Fig. 1.) In Blythe's ampere meter, a vertical solenoid has an adjustable core suspended from a spiral spring. A vernier gives the direct reading of from one-tenth of an ampere to 100 amperes.

The Deprez-Carpentier ampere meter came to the front about this time in

the succession. It contains two permanent magnets, bent half way round the inner circumference of a circular box. When nearly at the quarter of each side, the ends are bent inward, parallel with the diameter, and extend parallel with it until they nearly touch. Now we have two magnets, each not wholly unlike the capital letter C, with the open portions facing each other in the middle of the box. In the space left by the magnets, where the four poles so nearly join, is an electro-magnetic coil, which carries the needle and is actuated by the current traversing it. This was a bold step in advance. Kapp modified the Deprez-Carpentier instrument by making the magnets electro-magnetic, instead of permanent. The scale was graduated experimentally, and the instrument was formed for an ammeter or voltmeter, according to the size of wire used. Here was quite a radical departure. Uppenborn developed a novel idea in the use of an eccentrically shaped armature lying on a simple electro-magnet core, and a pointer fixed to the same axis as the armature. The pointer stands at one end of the curved scale when at zero. As the current increases, the eccentric face of the rolling armature gives to the pointer a movement along the scale, and a direct reading may be had. This graduation is arbitrary—done by a sort of cut and try method, or thumb rule. The improved voltmeter of this form has two coils instead of one, the greater to extend its sphere of usefulness. A switch gives choice of the coils.

There are forms in which the needle is loaded with small magnets, and the poles of electro-magnets are so placed as to double the magnetic action of these on the balanced needle. The molecular structure of glass is so affected by the magnetism as to change the direction of a beam of light transmitted through it, and this property has been taken advantage of to measure currents of electricity by the deflection of a ray of light. In one of that form of voltmeter, which measures current by the expansion of a wire through the heat generated by the passage of a current, some improvement has been made. In this a wire of platinum silver is inclosed in a brass tube, held in tension by springs or weights. Formerly the absolute tension of the wire did not give exact results if the wire was exposed to changes of atmospheric temperature. Even when not in use, the zero of the instrument is changeable. In the more recent instrument the brass tube surrounding the wire is made to have the same coefficient of dilitation as the wire itself, so that by compensation the zero remains very nearly absolute. The outer air has no longer any power to change and falsify the record of the instrument. Another form of voltmeter in which the dilatation of a wire is utilized to measure current pressure is a modification of the last. There were unforeseen difficulties in the way of accuracy. The increased length of the wire was assumed to be solely due to heat expansion, but investigation showed that with that expansion there must be considered the change in stress consequent upon the elongation and the accompanying increased sag. A remedy very similar to the former remedy was applied, and the work is now sufficiently correct for all practical purposes.

A French invention is dependent for its results upon the action of solenoid

attraction upon a movable core, the depth of this plunge being compensated by a weight which slides on a steelyard arm attached to the pointer a method of weighing the current. Deprez, according to Niaudet, conceived the idea of valuing current by weighing it by the aid of a solenoid coil. The scale of proportions was arrived at by actual experiment. A certain known current balanced a given weight. A second current would balance a greater or less weight, according to its quantity, and thus he was enabled to say "with a magnet of such and such proportions I find that a current which weighs blank grammes is a current of ten amperes."

A well-known inventor has endeavored to utilize the heat generated by a current to turn a horizontal wheel, against the diagonal paddles of which the rising air impinges. In another form there are two upright solenoids and two cores. These cores are fixed to, and are a part of, a rectangular frame which moves on two centers at the middle of the top and bottom bars of the

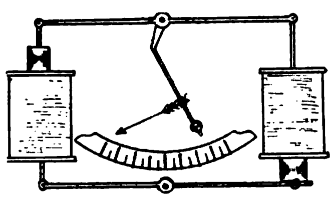


Fig. 2

frame. At two diagonally opposite corners the cores are placed, and the winding of the coils is such that when one core is sucked up into one coil, the other is drawn downward into the other coil. This see-saw motion is communicated to the pointer from its being fastened to the frame at the upper center of motion. A counterweight tends to hold the pointer at zero when in a state of rest. (See Fig. 2.)

Measurement of the gases developed by the electrolysis of acidulated water was one of the first as well as simplest of apparatus. Secondarily, the heat so generated has been made to do duty as a meter. An ingenious German inventor endeavored to utilize the heating effect of current by the aid of a double thermometer, the two branches connected with a thermopile in a way to increase the temperature in one branch and reduce it in the other, through the Peltier effect, when current is sent through the thermopile. Walker, in 1885, and Wolf, 1886, also utilized the electrolysis of acidulated water with platinum electrodes. A Russian electrician measured the time necessary for the evolution of one cubic centimetre of hydrogen by a given number of amperes of current. From this as a starting point he has formed a table showing the time necessary to disengage one unit of gas with one unit of current at temperatures varying from 15 degrees to 24 degrees centigrade.

A German was among the first to discard springs and permanent magnets in ampere meters and voltmeters. His instruments were galvanometers, with regulating pieces of soft iron for adjusting the index pointer. An

English firm followed about the same time with a novel idea in ammeters, in which the compound action of magnet upon magnet was utilized. To escape the use of springs and permanent magnets, a French inventor produced an instrument in which a plate of soft iron is affected by opposing magnetic influences, being both repelled and attracted. The use of this instrument requires either a mathematical education, by meaus of which to calculate the result, or some other instrument of a simpler character to verify the work. The use of this form of meter is not unlike reading fiction to learn history. If the reader knows the history beforehand he does not need the fiction. If not, it may be somewhat difficult to separate the true from the false.

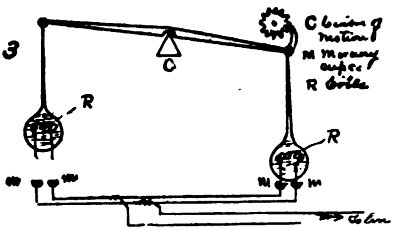
Simplicity is made simpler in another form, where the inventor uses an electro-magnet with a multiplicity of armatures, each held back by its own retaining spring. The more current you use for bait, the more armatures you will catch. All you need to do is to count them. A novel form had its origin in Berlin. In this, the pivot of the index needle lies within the solenoid, and one or more short, fine wires are attached to this center, at about right angles to the needle. The magnetic action tends to set these, which are in fact one armature, at right angles to the current, and as a consequence the indicator is moved along the scale. The weak point in this and many other clever instruments lies in the fact that magnetic action is not proportional to the angle of deflection, but to the tangent of that angle. An Austrian inventor places the needle between two contact screws, and any deviation from normal voltage closes the circuit through one or the other of the two coils, having differently toned bells, so that the employés are warned not only that the pressure is changed from normal, but whether it is above or below that point.

A European device, in quite extensive use on the continent, has two clocks with pendulums so adjusted that in their normal condition their motions are perfectly synchronous, though independent of each other. One of these pendulums terminates in a fork, which holds a spool of fine wire, and this last is free and swings back and forth in a coil of coarser wire, like a core in a solenoid coil. The main current energizes the larger or stationary coil, while the movable coil of fine wire is in a derived circuit from the main line. The mutual action of the magnetism in the two coils, of course, varies the pendulum motion, and a set of clockface counters—similar to those on a gas meter—registers the amount of current.

The heat developed by resistance offered to the passage of a current has been utilized to vaporize a liquid and produce motion in an ingenious manner. A horizontal lever has dependent from either extremity a closed bulb containing a fluid. The two bulbs are connected, and in their normal condition are balanced. Within the fluid a coil is placed, its terminals extending down through the bottom. When either bulb is depressed these terminals dip in mercury cups and complete the circuit. Heat is generated in the coil, the liquid is vaporized, and the vapor makes its way over to the other bulb where it is condensed. By and by the balance is destroyed and the beam tips, breaking the circuit on one side and making contact on the

other. The operation is repeated alternately from either direction, and every time it makes one complete vibration, a ratchet wheel is pushed one notch ahead by a dog attached to the tilting lever. (See Fig. 3.) To obtain a permanent record of the meter's work, a well-known French maker of instruments of precision added a revolving drum of paper, on which a pencil attached to the index lever traces the variations of voltage.

Fig 3



A very clever method of getting the pressure of a high voltage system by means of a low voltage instrument, has been used with fair success by the aid of high resistance incandescent lamps. A sufficient number of these, arranged in series, are placed in a derived circuit around the motor dynamo or lamps. When the proper number of these is introduced in the circuit to

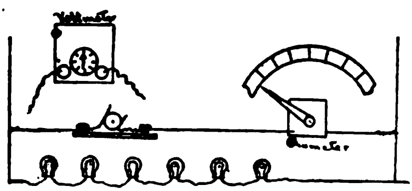


Fig 4

bring their candle power up to proper brilliancy, the lamp resistances are measured separately, and the aggregate is comparatively the difference of potential between the terminals—a good approximate system where no better can be obtained. (See Fig. 4.)

Of electrolytic meters there have been many. One of novel construction is an American invention. In this apparatus the entire line current is passed through a solution of caustic potash. The gas evolved, after being forced through water to clear it of froth or other impurities, passes into a meter similar to that used for gas measurement, whence, after having moved the dial, it is permitted to escape into the open air.

In this class of meters there are probably none better known than those in use by the Edison system throughout this country and Europe. Their action is based on the electro-chemical deposit of zinc, an average of 1,224 milligrams

of zinc per hour per ampere. Of these, for different purposes connected with that system, several have been brought out. A very ingenious one, with which you are all familiar, has the lamp attachment, by which a safe temperature is insured to the meter.

The Wheatstone bridge principle is used in one form of pressure indicator for constant potential plants. The circuit to be measured includes a lamp through which the current flows. The amount of current passing is determined by its voltage, and the resistance of the filament is measured by the heat developed. The scale is so graduated that at any time when the needle of the galvanometer is brought to zero, thus balancing the bridge, the index pointer gives a direct reading of the current pressure. Another modification of the bridge principle is used for constant potential current measurements. In this form one or two standard cells are placed in derived circuit around a variable resistance. The battery is opposed to the current under examination. When, by sliding the contact along the scale, the needle is brought to zero, the pointer indicates the voltage sought.

When the question is of meters for alternating currents, the problem is much more complicated, but the inventors, nothing daunted, have, since the comparatively recent introduction of these systems, done an immense amount of attempting with some success. Many of these are of such recent birth that patents have not yet been secured, and inventors are somewhat reticent about having their little ones paraded before the electrical public too early, for reasons of their own. Siemens' electro-dynamometer was one of the earliest instruments for measuring the potential of an alternate current. In this the inventor availed himself of the mutual reaction between two coils, one within the other. The inner coil is connected to the circuit on one side through the torsion spring which holds it in suspension, while the other terminal rests in a mercury contact. This arrangement permits of a rotary motion without breaking the connection. The deflected coil is brought back to zero until it will no longer deflect. The pointer gives a reading which is proportional to the square of the current. It will be readily seen that no matter how often or how slowly the alternations take place, the result must be the same, for no sooner does the direction change in one coil than the other is similarly affected. Another form of induction instrument is described in a German technical journal. In this there are no less than four coils, two main and two secondary. A Wheatstone bridge figures in the combination, and plays an important part in the apparatus, which is too complicated in its detail for any but an extensively illustrated explanation.

As early as 1884, the current itself was made to do duty in energizing an electro-magnet, as up to that date permanent magnets were unsatisfactory; but Weston's new instrument, in which a permanent magnet is used, I have seen tested with very rough usage without perceptible change. The method of magnetization, I believe, is known only to the manufacturers.

Objection has been made to the use of springs in measuring instruments, because of an assumed liability to change in form or elasticity. This assumption seems to me fallacious when we consider the reliability of delicate

mechanism like time-keeping machinery, in which a spring not only furnishes the motive power, but a spring as delicate almost as it is possible to make, is the regulator as well, and when we remember the permanent molecular changes which might be expected to arise from the rapid doing and undoing of the delicate hair-spring, or the heavy and powerful daily movement of the driving spring.

Many more systems might be mentioned. Indeed, one hardly knows where to stop, for every weekly report from Washington adds to the list of instruments for the measurement of either pressure or quantity of work, or something. Many that I have mentioned are out of place, save in the laboratory, while as to the correctness of the results obtained, electrical doctors disagree to an alarming extent. As a result, the majority of ampere meters in industrial use to-day are known as ammeters, and for simplicity of structure are little more than a stick and a string—a hollow coil, which is the arc of a circle, the center of which is the center of motion of a radial arm terminating in a wire core with an index arm attached, which, in a state of rest, stands at zero. A solenoid, with a direct reading scale—that is all. If correct, it is all that is necessary—but who knows? Of the more complicated apparatus much may be said as to its accuracy of action. Those in which permanent magnetism is used have not hitherto retained the magnetism constant, and it is a mooted point between certain French and English electricians, whether there is any method by which an accurate measurement of an alternate current can be made by any known process. In a discussion of this nature, I can see perfectly well a little way back and do not purpose venturing an opinion. The change in the magnetic power of a horseshoe magnet has sometimes been attributed to the careless method of removing and replacing the armature. Prof. Hughes has suggested that the only constant magnet is one which, after thorough saturation, is hammered until every possible change of its magnetism is driven out of it. The small residuum is permanent, and not likely to change. Dr. Hopkinson, with other lesser lights, has repeatedly found that the employment of an astatic needle is imperative in the neighborhood of magnets and magnetic fields. The use of an iron casing does not thoroughly obviate the difficulty. The necessity for a constant is a serious drawback to the ordinary user, even should the calibration of the instrument remain unchanged. The use of the battery by which to energize an electro-magnet introduces another serious inconvenience. A standard battery is not at all times readily attainable—is not inexpensive, and may possibly be unreliable.

In galvanometer work, with a portable battery of standard cells, I have noted a marked difference in deflection through standard resistances, which I could not explain. The importance of convenient and constant, as well as simple, apparatus for the measurement of current flow, as well as potential, is of easy comprehension. It may be summed up in a single sentence, which might appropriately be framed and hung in the dynamo room, as a hint to the engineer and the dynamo tender. "It takes money to buy coal." Excess of pressure in a constant potential system means, as an electric light

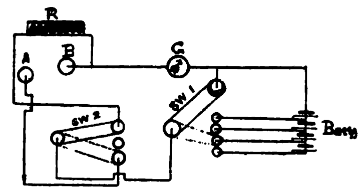
man once tersely remarked to me, "coal wasted, filaments busted, patrons disgusted." There is always a triangular duel between the patron, the company and the coal pile, on the subject of amperes, volts, candles and lamps and dollars. Now and again the wire men, too, are drawn into a wrangle on the subject of insulation, or the armature complains in a very feeling way that it has been abused needlessly. Thus, from every standpoint, the necessity of keeping a safeguard over undue waste is a vital question with the electric light men.

Hand in hand with apparatus for measuring current flow and current pressures should go instruments of precision for the daily measurement of line insulation and copper resistance. I use the phrase "instruments of precision" advisedly, as the only known apparatus in many localities, and in far too many stations, is as distant from being an instrument of precision as a bell-hanger is from being an electric wire man. As you are probably aware, this conviction is not a recent one with me. If there is any one thing in the whole business of electric lighting for which I have the most thorough and uncompromising dislike for testing circuits, it is the magneto bell. I wish I could feel that all my hearers were in full sympathy with this sentiment. The objections to the ordinary magneto are many and positive. In the first place, it is an alternate current generator, and will ring on a perfectly insulated line of sufficient static capacity, as readily as with a dead ground. There is positively no way of determining how much insulation resistance there is in the line. It will ring or it will not, and that is all you ever know. There is no degree of measurement. With one person who grinds it there will be a ring, while a less vigorous employé will fail to make any impression upon it. It becomes in the hands of line men who are encouraged to use it, a scapegoat for neglect, for laziness and a loss to the owner of the plant. It has not the range required for proper insulation of an arc line, nor even for a 50-light incandescent plant. The range of the ordinary magneto is less than 15,000 ohms.

With a tangent galvanometer, the measurements may be made by a little exercise of pencil and paper and the aid of a table of tangents. The intensity of the current, as measured by the tangent galvanometer, is proportional to the tangent of the angle of deflection of the needle. We will first obtain a constant by the measurement of a known resistance—say 10,000 ohms. Any other known resistance would be as well. We note the deflection, and turning to a table of tangents, note the tangent of 30 degrees. We next connect one pole of our battery to earth, and the other terminal to the galvanometer, which latter is connected to the line. All detectors and other earth attachments having been removed, the whole is now a metallic circuit. Closing the key, we note the deflection in degrees of our line insulation, and find the tangent of that figure in the table.

Now, the tangent of the first deflection, multiplied by the known resistance, 10,000, and divided by the tangent of the second deflection, will give us the number of ohms of line insulation resistance. Or, its tangent is to the deflection through the known resistance as the tangent of the second deflec-

tion inversely is to the unknown resistance. A very convenient little combination has been much used in Chicago, which answers an excellent purpose in construction work and testing, where all that is necessary is to reach a maximum insulation. In a small box, a battery is placed with a switch for connecting with a galvanometer through a standard resistance coil, or to line. Two binding screws receive the line connection and the earth wire. Having



Chicago Edison System Fig. 5.

placed the galvanometer needle in the magnetic meridian, the switch is turned, throwing the current through the known resistance. Note the deflection. Then switch to line. If the galvanometer needle deflects less than before, the insulation has more ohms resistance than the standard coil. A switch enables the operator to use any number of cells, from one to the full number, so that within a somewhat limited range considerable accuracy may be attained. (See Fig. 5.)

Every now and then the suggestion is made to place a permanent ground on an arc line, in order to know when a second ground occurs. The use of a safety comes in at once as a natural sequence. The suggestion is fraught with great danger to both life and property, and takes no heed of the time it requires a good healthy current to "get there." While it is true that the first ground does no harm, *per se*, it must be remembered that without a first ground a second ground is an impossibility, and the second ground is the troublesome one. There is a fascination about rigging up some sort of an arrangement for telling when there is trouble, rather than to keep the trouble at bay on general principles. An acquaintance brought to me one day, with his face all aglow, a sketch of a piece of clockwork, ingeniously arranged to make an instantaneous contact to ground once an hour while the plant was running. This ground contact had, between the line and ground, a safety device which held up a key to a second circuit, that could only close when the fuse melted. On this second circuit he had a battery and a bell located so that every one in the room must hear it, and continue to hear it until it was switched out or the battery ran down. It never worked, for I convinced him of its impracticability by asking him to form the second ground through his body as an experimental test.

Testing sets are made by various firms, which do excellently well for the species of measuring which may be necessary about the station or on the

line. The combination includes a Wheatstone bridge with a normal capacity up to over a megohm and down to fractions of an ohm. With an additional box containing extra coils, and a split plug and cord attachment, this capacity may be carried to twice or three times its ordinary capacity. A battery and galvanometer finishes the set, which is made up in two portable cases. No electric light station or plant of any consequence should be without some such means of electrical measurement, and no dynamo should be run without a daily test of insulation and a test of copper resistance. A bad joint may cost many pounds of coal, but a ground leak may be far more expensive in many ways, while both may be prevented by the proper constant use of a set of testing instruments. A daily record should be kept of these tests, together with the condition of the weather, etc. I have read somewhere of a ladder which was seen in a dream, the three principal rounds of which are faith, hope and charity, the greatest of these being charity. We have in the electrical ladder three principal rounds also. They are current, potential and insulation.

THE PRESIDENT: If there is no objection, before proceeding with the discussion of Mr. Haskins' paper, we will hear from Mr. Rhodes on the Economic Size of Line Wire.

MR. RHODES: My paper is so uninteresting and unintelligible, that the only way I can get it attention is to distribute printed copies. The writer has for some time been accustomed to use a formula for finding the size of line wire, and he has been requested to present it at this time. With the knowledge that it is not strictly new, and yet that it is needed by all practical electricians, the following is submitted:

ECONOMICAL SIZE OF LINE WIRE FOR CONSTANT CURRENT CIRCUITS.

BY BENJAMIN RHODES.

The writer has for some time been accustomed to use a formula for finding the economical size of line wire for constant current circuits and has been requested to present it at this time. With the knowledge that it is not new, and yet that it is needed by many practical electricians, the following is submitted:

Let X = diameter of line wire in mils.
" A = length of circuit in miles.
" B = price of copper per pound.
" C = cost of power per year per horse-power.
" E = amperes of current.

When any plant is about to be established, B and E are known, C can be determined near enough for our purpose, and A will be found to be immaterial.

$.016\ X^2 =$ pounds of wire per mile.
$.016\ B\ X^2 =$ cost per mile of wire.
$.0016\ B\ X^2 =$ interest and depreciation at 10 per cent.
$.0016\ A\ B\ X^2 =$ annual cost of wire. (1)

$\frac{54577}{X^2} =$ ohms per mile.

$\frac{54577\ E^2}{X^2} =$ watts per mile.

$\frac{54577\ E^2}{746\ X^2} =$ horse-power lost in transmission per mile.

$\frac{54577\ C\ E^2}{746\ X^2} =$ cost of same.

$\frac{54577\ A\ C\ E^2}{746\ X^2} =$ annual cost of power lost in entire circuit. (2)

It is plain that with any increase in the size of wire the value of (1) will increase while (2) will diminish, and the economical value of X will be such that the sum of (1) and (2) will be a minimum.

Let u=this sum.

$$u = .0016\ A\ B\ X^2 + \frac{54577\ A\ C\ E^2}{746\ X^2}$$

Differentiating.

$$\frac{du}{dx} = .0032\ B\ X - \frac{109154\ E^2\ C}{746\ X^3}$$

Placing this equal to zero, and reducing, we have:

$$X^4 = \frac{45700\ E^2\ C}{B}$$

This formula shows that diameter of wire depends on price of copper, cost of power and quantity of current, and is entirely independent of the length of circuit and voltage.

The differential coefficient shows that the formula is in harmony with Sir William Thompson's rule that "the additional running expense due to the resistance of the conductor shall equal the interest on its first cost."

Price of copper refers to the bare wire without any covering or insulation whatever. The insulating cover is a mere matter of choice, like a brick, stone or frame station.

A few examples are added for illustration, the price of copper assumed at 20 cents per pound for facility of calculation.

What size wire should be used in a transmission of power plant using a 40 ampere current, power costing $100 per year per horse-power?

Here E—40, C—100, B—20, substituting X—427 mils or nearly 0000 wire B. & S. gauge.

If the power cost $50 per year, then C—50 and X—359, or 00 B. & S. With water power at $10 per year, X—240 or between 2 and 3 B. & S.

Should a 20 ampere current be used in the three cases above, the results would be, respectively:

X—302, which is larger than 1 B. & S.
X—250, " " " 2 B. & S.
X—170 between 5 and 6 B. & S.

What size wire is economical in an ordinary city arc light ten ampere circuit, steam power costing $50 per year?

E—10 C—50 B—20

Giving X—180 or No. 5 B. & S.

Suppose water power can be furnished at Niagara Falls for $10 per horse-power per year and a ten ampere current generated by this power be used for street lighting in Buffalo, the entire length of circuit being 50 miles, what is the economical size of line wire?

A substitution in our formula gives X—120 mils, equal to No. 8 wire B. & S., or exactly No. 11 Birmingham wire gauge.

In conclusion, Mr. Rhodes explained that the No. 11 Birmingham wire gauge wire, given as the economical size of the line wire carrying the ten ampere current between Niagara Falls and Buffalo, would be about one-half of the diameter of an ordinary lead pencil.

THE PRESIDENT: Gentlemen, you have before you the papers of Mr. Haskins and Mr. Rhodes.

DR. MOSES: I move that they be received and filed and spread upon the minutes.

(The motion, after being duly seconded, was put and carried.)

THE PRESIDENT: Gentlemen, we have, for the special order of business, at 11 o'clock, which has very nearly arrived, the report of the Committee on the Revision of the Constitution and By-laws, through its chairman, Dr. Moses.

MR. MORRISON: Mr. President, have you not printed copies of the Constitution that can be distributed to the Association?

(The Secretary brought in a number of printed copies, showing the old and new Constitutions, and they were distributed among the members.)

DR. MOSES: This report is of a committee of five, appointed at the Chicago Convention, who were invited to report at this Convention on some necessary amendments to the Constitution. The opinions of all the members of the Association were sought

with regard to certain changes, thought advisable then, and we have a mass of material, amounting to some 125 letters, some of them quite carefully written, and giving great encouragement to the committee to proceed in these amendments, which are on file with the Secretary. The amendments are not many, but comprise a change of some importance in the form of the Constitution ; and I will call your attention to a few of these points after I have read the proposed Constitution.

Dr. Moses then read the proposed Constitution, as follows :

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

REPORT OF THE COMMITTEE APPOINTED AT THE CHICAGO CONVENTION, FEBRUARY, 1889, TO REPORT AT THE NEXT CONVENTION ON THE REVISION OF THE CONSTITUTION.

PRESENT CONSTITUTION.

ARTICLE I.—*Name.*

The name of this Association shall be THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

ARTICLE II.—*Membership.*

SECTION 1.—Any individual or member of a company or firm operating an electric light, power, heat or welding station for public or commercial purposes; and any individual or member of a company or firm manufacturing electric supplies or apparatus, may become a member of this Association by the payment to the Treasurer of one year's dues.

SEC. 2.—Electricians, Electrical Engineers, and those whose profession or business is directly related to electrical interests or to the commercial application of electricity, may, upon the recommendation of the Executive Committee and a two-thirds vote of the Association, become members thereof, by the payment to the Treasurer of one year's dues.

SEC. 3.—Upon the unanimous recommendation of the Executive Committee and the approval by a two-thirds vote of the Association, persons may be made honorary members of the Association, with all the privileges of membership, except the right to vote.

ARTICLE III.—*Officers.*

SECTION 1.—The officers of the Association shall be a President, two Vice-Presidents, a Treasurer and a Secretary, and an Executive Committee, to consist of the above-named officers, *ex-officio*, and nine other members.

SEC. 2.—The President and Vice-Presidents shall be elected by ballot, to serve from the close of the annual meeting at which they are elected until the close of the next annual meeting.

SEC. 3.—No person shall be eligible for the office of President or Vice-President for more than two successive terms, but this shall not be construed to forbid the election to the office of President of one who has served as Vice-President.

SEC. 4.—The Secretary and Treasurer, who may be one and the same person, shall be nominated by the President, subject to confirmation by the Executive Committee. The salary of the Secretary shall be fixed by the Executive Committee.

SEC. 5.—The Executive Committee shall be chosen by ballot at each meeting, either annual, semi-annual or special, and hold office from the close of the meeting at which they are elected until the end of the meeting at which their successors are chosen.

SEC. 6.—The Treasurer, Secretary and Executive Committee, shall make written reports at each meeting, which reports, upon their acceptance, shall be spread upon the records of the Association.

SEC. 7.—The Executive Committee shall be the governing body of the Association. They shall meet at the call of their chairman, from time to time, and shall report upon applications for membership, shall gather and prepare information upon topics of interest, and shall arrange for their discussion at the several meetings of the Association. Five members of the Committee shall constitute a quorum.

ARTICLE IV.—*Meetings.*

The Annual Meeting of this Association shall be held in February, and a Semi-Annual Meeting may be held in August of each year, at such places as the Association shall determine, and on such dates as may be determined by the Executive Committee.

ARTICLE V.—*Dues.*

The annual dues shall be $20, payable in advance, and shall cover the calendar year.

ARTICLE VI.—*Ballot.*

On any question before the Association a ballot may be demanded by ten of the members present.

ARTICLE VII.—*Amendments.*

SECTION 1.—Amendments to the Constitution shall be presented in writing and referred to a committee to be appointed by the Chairman before being acted upon by the Association; a two-thirds vote of those present shall be necessary to their adoption.

SEC. 2.—No amendment shall be voted upon on the day of its first presentation.

PROPOSED CONSTITUTION.

ARTICLE I.—*Name.*

This Association shall be entitled THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

ARTICLE II.—*Object.*

The object of this Association shall be to foster and protect the interests of those engaged in the commercial production of electricity for conversion into light, heat and power; and of manufacturers of apparatus and supplies used in these industries.

ARTICLE III.—*Members.*

SECTION 1.—Members shall be divided into three classes: *Active*, *Associate* and *Honorary*, of which the *first only* shall be entitled to vote.

SEC. 2.—Active members shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use, and the members of the Executive Committee.

SEC. 3.—Associate members shall be electricians, electrical or mechanical engineers, manufacturers and individuals who are otherwise directly or indirectly interested in advancing the uses of electricity.

SEC. 4.—Honorary members of the Association may be elected upon the unanimous recommendation of the Executive Committee and approval by a two-thirds vote of the Association.

ARTICLE IV.—*Officers.*

SECTION 1.—The officers of the Association shall be a President, Vice-Presidents, a Treasurer and a Secretary, and an Executive Committee, to consist of the above-named officers, *ex-officio*, and nine other members, of whom three shall be selected from among the Associate members.

SEC. 2.—The President and Vice-Presidents shall be elected by ballot, to serve from the close of the annual meeting at which they are elected until the close of the next annual meeting.

SEC. 3.—No person shall be eligible for the office of President or Vice-President for more than two successive terms; but this shall not be construed to forbid the election to the office of President of one who has served as Vice-President.

SEC. 4.—The Secretary and Treasurer, who may be one and the same person, shall be nominated by the President, subject to confirmation by the Executive Committee. The salary of the Secretary shall be fixed by the Executive Committee; and he shall have an office in the City of New York.

SEC. 5.—The Executive Committee shall be chosen by ballot at each meeting, either annual, semi-annual or special, and shall hold office from the close of the meeting at which its members are elected until the end of the meeting at which their successors are chosen.

SEC. 6.—The Treasurer, Secretary and Executive Committee, shall make written reports at each meeting, which reports. upon their acceptance, shall be spread upon the records of the Association.

SEC. 7.—The Executive Committee shall be the governing body of the Association. It shall meet at the call of its chairman, from time to time, and shall report upon applications for membership, shall gather and prepare information upon topics of interests, and shall arrange for discussions at the several meetings of the Association. Five members of the committee shall constitute a quorum.

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ARTICLE VIII.—*Amendments.*

SECTION I.—Amendments to the Constitution shall be presented in writing and shall be referred to a committee, to be appointed by the chairman, before being acted upon by the Association; a two-thirds vote of those present shall be necessary to their adoption.

SEC. 2.—No amendment shall be voted upon on the day of its first presentation.

Respectfully submitted,

OTTO A. MOSES, Chairman,
WILLARD L. CANDEE,
A. J. DE CAMP,
MARSDEN J. PERRY,
H. D. STANLEY,
Committee.

DR. MOSES: In this proposed Constitution, gentlemen, you will notice that there are certain changes, some of which affect myself and others of my committee materially, but it was thought by me and my coadjutors in this matter that it was important that these changes should be brought about in order to give more homogeneity to the Association, and to give it its true position as a body. I hope that the mature deliberation that has been given to this, the labor that has been expended upon it, and the disinterested feeling that has prevailed in forming it, will be acceptable to you.

MR. CHARLES A. BROWN (of Chicago): Mr. President, I move that the report of the Committee on the Revision of the Constitution be accepted.

The motion was seconded by Mr. De Camp.

Mr. E. T. Lynch, Jr.: Mr. Chairman, I would suggest that as this proposed Constitution is very important, we take it up *seriatim* and discuss it, article by article, and pass upon it so. One or two little changes I would like to suggest, and I think that would be the most satisfactory to all.

Mr. J. F. Morrison: The motion is not in order. You accept the report, and then discuss its provisions.

On motion, duly seconded, the report was accepted.

Mr. Charles A. Brown: Mr. Chairman, the report of the Committee on the Revision of the Constitution having been accepted, I would now move you that a committee of five be appointed by the President for the formulation of by-laws or rules of order for the Association.

Mr. George W. Phelps: I second that motion.

Mr. Fred. H. Whipple: Do I understand that this Constitution has been adopted?

The President: Accepted.

Mr. Fred. H. Whipple: What do you mean by accepted?

The President: That it is now the Constitution of the Association.

Mr. Fred. H. Whipple: There is a difference of opinion here, as to whether this matter is before the Convention, or whether it has been adopted.

The President: The ruling of the Chair is that it is now the Constitution of the Association. The word used by Mr. Brown was accepted.

Mr. Fred. H. Whipple: Does that adopt the report? The acceptance of the report does not, as I understand it, adopt it. If the report had been received, that would be right, but it was accepted and was open for discussion.

Mr. Lynch: My motion was made with the understanding that the report was to be received. I do not think we should quibble as to whether it is adopted or received. Some of the members want to talk on the changes meditated in the Constitution.

The President: The discussion is out of order. All discussion to this point must be on Mr. Brown's motion for the appointment of a committee of five on by-laws.

MR. J. F. MORRISON: Mr. President, I move as a substitute that the Executive Committee be instructed to prepare by-laws.

MR. CHARLES A. BROWN: I accept that amendment.

This motion being duly seconded, was carried.

MR. FRED. H. WHIPPLE: I move that the motion of Mr. Brown, to accept the report, be reconsidered.

MR. CHARLES A. BROWN: Mr. President, I would like to ask how the gentleman voted on that question?

MR. FRED H. WHIPPLE: The gentleman did not vote at all.

MR. CHARLES A. BROWN: I rise to a point of order, that as he did not vote upon the question he cannot call for reconsideration.

THE PRESIDENT: Mr. Brown's point is well taken. We will now hear from Mr. G. W. Mansfield, of Boston.

MR. E. T. LYNCH, JR.: I think I voted on that subject, although my voice was very low. (Laughter.)

THE PRESIDENT: The Chair rules that Mr. Mansfield has the floor.

MR. GEORGE W. MANSFIELD: Mr. President, members of the Association, ladies and gentlemen:—It gives me pleasure to be able to present this paper before you, to-day, upon the application of electricity to street railways.

Mr. Mansfield then delivered the following paper:

ELECTRIC RAILWAYS.

BY GEORGE W. MANSFIELD.

The application of electricity to street railways has been so rapid that we are liable to lose sight of many valuable points in our herculean efforts to supply the demand. Those who are engaged in it, know that they let many opportunities slip by. They cannot help it. The more generally, however, the points are known, the quicker will be the reward to some directly, and to them indirectly.

The application of electricity during the past decade has been astonishing. In the face of an industry a half century old, and of enormous wealth and power, it has won the leading position. In every direction that honest effort has been made, it has succeeded. Commercial barriers have been broken down and physical obstacles swept aside. When once the feasibility was demonstrated the end could not be predicted.

For the transportation of the people in the streets of our towns and cities, the demonstration has been witnessed, the application made, and a wonderful

luxuriant growth started. There is no industry so far-reaching in character, so vital to a community's interests, and yet one so little known as the street railroad business. Neither the scientific world, the commercial world, nor the people themselves, have realized its vast importance. Eliminate the horse car from every city or town in the Union, and forecast the results.

In 1828 the now great Baltimore & Ohio Railroad started, and horses were used to draw the cars. This might be called the first horse car line in the United States. In 1830 there were 12,866,020 persons in the United States, and not a mile of street railroad nor scarcely of steam road. As a rule, the New York & Harlem Railroad, incorporated in 1831, is spoken of as the first street railroad in the country. The first car was run in November, 1832, from Prince Street to Harlem Bridge. In 1837 it temporarily succumbed to steam cars, but resumed in 1845.

The census of 1850 gives our country a population of 23,191,876, and published history of but one street railroad. The child had been born, however, and in 10 years the street railroad was in almost every city of any magnitude in the country. To what has this child grown! In 1880 our population was 50,155,783. Estimating on an increase of 33⅓ per cent. in 1890, or six months hence, the population will be 66,874,354. For the transportation of this number of people in the streets of our cities and towns, the most accurate figures it is possible to obtain, show the engagement of about 425 companies, employing 28,000 cars, 125,000 horses, and operating some 3,500 miles of track. The capital invested is variously estimated from $175,000,000 to $200,000,000. The number of passengers carried is so enormous that it is impossible to obtain figures of any great degree of accuracy. As a result of most careful compilations and estimations, it is reasonably sure that at least 1,500,000 passengers are transported.

Still more striking is the importance of the street railroad business when compared with the magnitude and extent of the steam railroads of the United States. The figures of 1887 show a tabulation of 147,998.60 miles of railroad and 20,582 passenger cars, and passengers carried but 428,225,513. With nearly an equal number of cars and 42 times more road, only one-quarter as many passengers were carried. Behold the yet more amazing figures: The horse cars of the City of New York carry 199,491,735 passengers, almost half as many as are carried by all the steam roads in the United States. If to this number are added those carried by the elevated roads, we have the total of 371,021,524, or almost as many passengers are carried in New York City alone as are annually carried by all the steam roads in the whole United States. The street railroads of the State of Massachusetts carry over 44,000,000 more people than all the steam roads in that State. One road alone, the West End, of Boston, carries nearly 10,000,000 more than all the steam roads combined.

To show somewhat in detail where this tremendous traffic is, I have prepared Table I. Most of the figures showing passengers carried were obtained from reliable sources, and the balances were estimated from an average obtained from those I was sure in regard to. If you figure for each car six

TABLE I.—CITIES OF 100,000 POPULATION OR OVER.

Name.	Companies. Elevated.	Companies. Horse.	Miles single track.	Total track-age.	No. of cars.	No. of horses.	Locomotives.	Total passengers carried.
New York	2	....	60	89	949	......	291	171,529,789
	....	19	143	268	2,300	14,441	....	199,491,735
Brooklyn	3 miles cable included.	14	135	207	2,355	8,410	....	105,975,249
	3	....	24	35	247	......	91	18,632,082
Boston	....	1	211	231	1,534	7,684	....	97,039,919
Providence	....	1	54	54	289	1,414	....	15,582,732
Chicago	44 lines in one system.	7	325	325	2,400	8,279	....	99,348,000
Philadelphia	....	12	302	326	1,512	322	8 dummies	143,433,959
St. Louis	3 cable.	14	169	169	1,058	4,231	....	50,772,000
Baltimore	....	12	158	158	460	3,167	....	34,837,000
Cincinnati	2 cable.	30 lines, 7	164	164	530	2,644	4 dummies	31,728,000
New Orleans	....	7	140	140	499	2,019	18 dum's, 7 loco's.	24,228,000
San Francisco	2 steam, 8 cable.	10	163	164	707	1,724	3 loco's, 39 dum's.	130,860,000
Buffalo	....	2	39	56	198	1,276	....	13,108,203
Washington	....	5	63	63	336	1,684	....	21,892,000
Newark	....	3	53	52	219	1,264	....	15,168,000
						Mules		
Louisville	....	2	112	112	378	2,270	....	24,970,000
						Horses		
Cleveland	....	7	123	123	523	2,521	....	30,252,000
Pittsburgh	6 cable, 1 electric.	13	113	113	347	1,924	3 dummies.	39,088,000
Jersey City	....	2	35	35	132	825	....	10,725,000
Detroit	3 electric.	4	65	65	263	1,682	....	32,184,000
Milwaukee	....	3	68	68	208	1,188	2 loco.	16,744,000
Albany	....	3	19	30	103	424	....	4,278,927
Indianapolis	Consolidated.	1	40	40	99	648	....	9,720,000
Kansas City	6 cable.	7	124	124	469	613	38 dum. and motors.	33,969,000
St. Paul	1 cable.	1	74	74	154	816	....	23,608,000
Omaha	2 cable, 3 electric.	1	61	61	167	580	24 motors.	20,540,000
Minneapolis	Consolidated.	1	66	66	160	1,104	....	14,352,000
Totals	....	189	3,103	3,414	18,645	77,884	....	1,434,057,595

Five elevated roads, 27 cable, 147 horse, 7 electric, 3 steam and horse combined—189, total; 18,645 cars, 394 locomotives, 134 dummies and motors; 77,884 horses, 2,270 mules—80,154. About 24,000 horses are annually disabled.

horse-power of electric energy, it will give you a rough idea of the size of an electric central station needed to operate all the cars. In New York City, dynamo capacity of 13,800 horse-power would be demanded; in Boston, 9,504 horse-power, and so on. This is destined to come as surely as the days succeed each other. In Boston it has come, and a station of approximately 8,000 horse-power is already in the hands of the engineers. If the conservatism of Boston permits it, how can the result be but inevitable for the other great cities of the Union. This enlightened age will have these facilities for transportation, and as soon as it is possible and wise. The universal cry today in almost every large city, the length and breadth of the land, is for cleaner, surer and more rapid transit.

Unfortunately, the tendency of the times is to concentrate in or around large cities. This means congestion, with all its deplorable results. The solution lies to a very large extent in the street railways. These must be the cities' arteries and veins extending from the heart in all directions to the extremities. Improve, then, the street railways. Almost every method of applying energy to street cars has been applied, and they all have, finally, except electricity, "bitten the dust" in the great battle for life.

The Baldwin Locomotive Works have for years been engaged in the manufacture of steam dummies for street railways. Unquestionably through them the highest order of talent and skill has been lavished upon the solving of the vexed problem as to how to use steam for the haulage of street cars. Motors weighing from 13,000 to 27,000 pounds, when in working order and ready to run, have been built. In most cases two engines have been employed, with cylinders and strokes ranging from 8 inches by 10 inches to 12 inches by 16 inches. The power of these engines can be judged from their pulling capacity, which varies from 320 to 634 tons on a level, and from 16 to 43 tons on a four per cent. grade. Ordinarily they were built to seat from 15 to 20 people. The wheel base was generally six feet, and the wheels 31 inches in diameter. Naturally they were built to run at speeds from 10 to 15 miles per hour, and to be provided with all possible safeguards and conveniences. Powerful brakes were used, coke was burned to avoid smoke, mufflers provided for the exhaust and safety valves, and every other possible contrivance adopted to eliminate all objectionable troubles. Their economy in working has not been very freely published. From reliable and authentic sources we learn that the lowest fuel consumption is 6½ pounds of coke per mile run. The average is from 15 to 12 pounds when ordinary grades are ascended. The total cost of operating per mile has been in some instances reported to be but 3½ cents, but in other cases it was found to be over 20 cents per car mile. It is needless to say that in spite of all the skill, time and money spent upon them, they have not proven, except in a few isolated cases, either satisfactory or economical.

Electricity, the youngest of them all in application, shows already the sturdy, vigorous growth that inevitably will result in its complete supremacy.

TABLE II.

ELECTRIC STREET RAILROADS.

	1885.	1886.	1887.	1888.	Jan. 1–July 1, 1889. Operating.	Building.	Total.	Total.
Number of electric railways	3	5	7	33	19	42	61	109
Number of miles of road	7.5	28	29	130.5	113	267	380	575
Number of cars	13	39	81	265	174	364	538	936

The figures of Table II certainly show that the facts warrant the prediction. They were most carefully prepared and include every road of any record. It does not show it all either. That remarkable contract which the West End Street Railway Company, of Boston, the largest street railway company in the world, signed recently with the Thomson-Houston Electric Company is not included under the heading "roads building in 1889." I think that this contract in responsibility and importance is one of the greatest that has ever been signed in the history of electricity. In electric railroading it is the greatest and probably will be for many years to come.

The West End Street Railway Company, of Boston, owns 217 miles of track and 1,584 cars, all of which are to be equipped so as to be operated with electricity. Add these to the list, and how does our list stand? If it be within the bounds of the supply men, at least 75 miles will be built this Summer and 100 or more cars equipped. Will not this give the electric railroad industry a stand warranting the attention of the whole railroad world? As an interesting comparison regarding the new industry, if I may call it such, note the following figures:

	1870.	1880.	1890. Estimated.
Total h. p., both water and steam, engaged in the whole manufacturing industry of the U. S.	2,346,142	5,410,837	5,255,582
Total h. p. engaged in the electric lighting and power industry	0	1,000	500,000
Total h. p. engaged in electric railway industry	0	0	30,000

In meeting this demand of the age for better transit there are many considerations that claim our most careful attention. The conditions to be met are widely different from all other electrical applications. Essentially we have first, a steam engine; second, a dynamo; third, a conductor, and fourth, a motor mounted upon a vehicle and subjected to mechanical and physical conditions more extreme and severe then ever heretofore has been imposed upon any piece of electrical machinery. In the battle for success the engine has to stand the bulk of the fighting. Anything wrong with it affects directly

the electric system, and in many cases it also has to stand the blows if anything is wrong with the electrical system. Dr. Bell has pointedly shown in his valuable paper many well known facts, and clinched them by figures taken on one particular road. They can be taken with certain allowances as fairly representing the conditions imposed upon the steam engine by an electric road.

The extreme liability of short circuits on the road from falling wires, careless drivers turning the current on too suddenly when starting, and a variety of accidents that may happen on the very best roads, render of the first importance that the engine have its main moving parts at least 20 per cent. heavier than ordinarily.

Under the extreme fluctuations of load, keys, nuts and bolts will work loose. An engineer in a large station recently told me that he practically took to pieces and put together nearly every month a 100 horse-power engine running an 80 horse-power dynamo, whereas, prior to the time that it had been connected to a railway dynamo it had given practically no trouble, although worked well to its capacity.

Hanscom, of cable railroading fame, writes: "We do not consider it good engineering to design an engine to suit the general average of all lines in the country." He argues special engines for every road. Mr. C. B. Holmes, president of the Chicago Cable Company, writes: "I would recommend that the strength of parts and weight of fly wheel be at least one-third greater than the usual run of engine power." Our business is analogous, and I think we should heed their counsel.

A compound engine rated at 109 horse-power, running an 80 horse-power dynamo under test, recently, gave the following:

Friction card with dynamo but no current, 11.65 horse-power.

Aggregate horse-power of cards, 1,247.74 horse-power.

Average horse-power of cards, 56.67 horse-power.

Maximum card, 120.79 horse-power.

Minimum card, 15.56 horse-power.

The cards were taken at 10 minute intervals for four hours. There were at the time three electric cars on the line, each towing another. As the day was a pleasant Sunday, every car was crowded. During the same time current and potential readings were taken on the line at the station. The average gave 30 horse-power, or an average efficiency of 54.6 per cent. for the total time. Every moment deducted that no current was flowing would raise this efficiency. At times the efficiency was far higher than this. The road conditions were severe, the grades ran as high as 10 per cent., and had numerous others of five and seven per cent. The extreme current fluctuations were noted in one minute's variation from 45 amperes to 140. The potential was very constant. On another small road the extremes varied from the friction load to nearly 85 horse-power on a 100 horse-power engine. These extremes would happen even during the time a three-impression card was being taken. Under such conditions the question of coal economy is a troublesome one. On large roads, unquestionably, a far better showing would be possible.

Laying aside the question of coal economy, which is cheap in comparison to food for horses, the best engine is the one that handles the average work with the least repairs. On some small roads the ratio of engine friction to averge daily load may be large. The great majority of roads, however, will have a sufficient number of cars to so reduce the ratio of extremes to the average load that the engine can work at its most economical point of cut-off the major part of the time, and raise the average load to such a point above the friction load that the per cent. lost will be comparatively small.

Almost the first question asked by the manager of an electric light company when an application has been made to him for power, is: "How much electric power must I allow per car?" No man can give a definite answer to this question that will meet all conditions.

If the following facts are known, a fair judgment can be made, although I am much afraid that the accuracy of the judgment would not be that of a William Tell.

1. Number of cars simultaneously operated.
2. Speed and nature of service.
3. Maximum grade, and number of grades.
4. Scheduled location of cars in reference to grades.
5. Motor cars to be used to tow others cars or not.
6. Any peculiarities in regard to the distribution of cars.
7. Condition of track.
8. Location of track in reference to power house.

A moment's thought over any one of these points, I think, will convince you of its importance. On a portion of the Cambridge division of the West End Street Railway Company's road, of Boston, the Thomson-Houston Company's motors commenced running February 16, 1889. Up to July 1, 165,781 miles and 25,505 round trips had been made, with a loss of but 325 miles, or .19 of one per cent., and 49 round trips, or the same per cent. of loss. During this time nearly 1,500,000 passengers were carried. This, in view of the fact that during the entire time one, and part of the time two, tow cars were drawn, is remarkable. It must also be known that the route extends over one of Boston's most crowded business thoroughfares, and is the main street connecting Cambridge and Boston.

On a portion of the route there is an open bridge about 1,800 feet long, on which is located one draw, which is opened from 20 to 30 times a day. Over this bridge 1,810 cars per day pass, or on the average of one every three-quarters of a minute, and at some portions of the day they run at half-minute intervals. The teaming on this street is also very heavy, necessitating constant stopping. You will see from these figures what the loss of current or a motor burn-out causing delay would mean. The record, however, has been magnificent. As the dynamos are run by the Cambridge Electric Light Company, and are so arranged that the same engines furnish power and lights for their own purposes, as yet only approximate data as to the fuel consumption, etc., has been possible. A few electrical tests have been made, as well as it were possible. Ammeter and voltmeter readings were taken at

the station every 15 minutes, for readings per minute, or at 15-second intervals. This was kept up from 6.30 A. M. to 12.30 A. M. next morning for five days. In all, 1,480 readings were taken. The average of these readings gave for 12.6 cars in continuous service, 111.6 amperes, 500 volts, or 74.8 horse-power. Per car this is 8.8 amperes and 5.9 electrical horse-power. The average number of passengers carried was about 58 per round trip. We now have 32 cars in operation, and observations, in so far as they have been taken, show a marked decrease in horse-power per car. At Richmond, Va., some rough tests gave the electrical horse-power required per car at the station as from 4 to 5. On the road at Lafayette, Ill., the figures of Dr. Bell show the remarkable low figure of 2.5 electrical horse-power. There are a number of circumstances on this road that would tend to make this figure so low. The cars are smaller than those ordinarily used, and I should judge that there were other circustances entering into the calculation that would tend to reduce it. However, it well shows, possibly, one extreme in railroading.

The other extreme might be cited in the case of the Lynn road, Highland division. Here only one car is in operation. In the course of its route it ascends a hill graded at the rate of 8.7 per cent. for 300 feet, and immediately passes down on the other side. In this case the engine was indicated. Five cards were taken when the car was ascending the grade, the average of which was 52.2 horse-power. If we allowed a dynamo efficiency of 90 per cent., this would indicate an electrical horse-power of 47 horse-power. This is unquestionably a very extreme and exceptional case. I might add, incidentally, that the car pays handsomely.

At Plymouth, Mass., a road having many heavy grades, the maximum being over 10 per cent., and operating but three electric cars, each with tow cars, the electrical horse-power at the station per car was approximately 7.72 horse-power. On the cars the extremes vary obviously, according to speed, grades, load, etc. It frequently reaches from four to five times the average value during the total time. In Lynn the variation is enormous. In Cambridge the current frequently rises to from 65 to 70 amperes, or about 42 horse-power. Especially is this the case on starting. You can see from these figures the impossibility of giving only the most approximate figures in this direction unless every detail as to operation and conditions are known. I feel, however, that on roads having no grades over five per cent., and operating under 10 motor cars with tow cars, 15 horse-power per car would be a safe figure for dynamo capacity. On large roads this figure could be reduced to 12 and possibly 10 horse-power per car, while on small three or five car roads with heavy grades, 18 or 20 horse-power might not be any too much. At Cambridge, tests show that, of the total time consumed by a car in a round trip, it was taking power only 61.8 per cent. of the time, and that 6.7 per cent. of the total time the car was stopped. At Washington, where the streets were freer and not so thickly populated, the above figure for time when power was used rose to 66 per cent. Neither of these roads are what you might call large. It seems, however, that from 30 to 40 per cent. of power in excess of the absolute require-

ments can be planned for. I do not think, however, that this can be implicitly relied upon as in other power business, since there are many factors in the general operations of a railroad system that might at any moment tax the central station to its utmost. In regard to total electrical and total commercial efficiencies, it is impossible for me or any one else to give accurate figures. There are so many fluctuating factors entering into such a determination, that, whereas, a test made to-day would give me certain figures, a test made to-morrow, or a week later, would give me entirely different figures. The time factor must enter largely into such a test.

From estimations based upon many figures, I feel certain that a total electrical efficiency of at least 70 per cent. can be obtained, and a total commercial efficiency measured from the indicated horse-power of the engine to the car wheel horse-power (W. H. P.) of from 45 to 50 per cent. If the road-bed, rolling stock, and all the electrical apparatus is maintained as it should be, I see no reason why this figure cannot be exceeded.

Unquestionably, to the railroad man, one of the most vital points is the costs of repairs. We all know that in so far as power is concerned, a horse-power can be produced and delivered 10 hours per day the year round, with a profit, at about $75 per year. The cost of maintaining a horse for only about four hours' work per day on a horse car is not far from $190.

There is one point which is of vital interest to the managers of electric light companies, and this is how they shall charge the railway companies for the power which they desire. I have already shown you that it is an exceedingly difficult thing to estimate upon the requisite power, as the conditions are so fluctuating and so variable. After, however, the question of the amount of power has been settled, the next point to determine is whether they shall charge the railway company by the hour, by the day, or by the car mile. We have a large number of roads already hiring power of local companies; all of the methods just mentioned are in use. Upon small roads, where the schedule of the railway company is such that they have only a few cars running continuously, meeting emergencies by extras, and where the grades are heavy, a satisfactory basis has been to charge so much per day per car, the price ranging all the way from $3 to $5, $6 and $7. When the roads are of moderate size, or are subject to many variations and sudden demands on the part of the public for better facilities, or when the line runs to some resort and the main bulk of business lay in picnics, etc., charges on the hour basis is sometimes preferred. This price varies from 15 to 30 cents per hour. On larger systems, where the schedule is definite and fixed, the mileage basis is the preferable by far. The prices on this basis range from two to six cents. You can readily see that if the cars ran at infrequent intervals, and if the morning and evening traffic was especially heavy and required a larger number of cars, while during the major part of the day only a few cars were out, the mileage basis would be quite unsatisfactory, since on the whole you would have to make steam possible for the maximum railroad output, and maintain it throughout the day. All of these estimates, however, can only be determined by knowing the local conditions and circumstances.

In the East, where coal ranges from $4 to $5 per ton, naturally the prices could not compete with the railroads of the natural gas and coal regions, where fuel can be obtained for almost nothing, as in some cases, for 10 cents per ton.

I would like now to enter a wedge here in favor of the very best of construction. Your own experience has probably dictated that there is no economy if the original construction be put in with either inferior or faulty material or apparatus. It is more important in railroading than possibly in lighting that the overhead construction, the track circuit, the wiring of the cars and all other details be as perfect as it is possible for the best skill and brains to make them. If the light companies would require proper and reasonable guarantee in this direction, whenever they do supply power, it would not only be a surety in regard to their own protection, but also would be a strong inducement for the very best of construction work. The railroad man should see that it is for his interests, since there is no trouble that will consume profits more rapidly than breakdowns. There is no excuse now for electrical breakdowns. When such do happen it is either carelessness or cheap construction.

Railroading is an exact business. The cars must be ready and go precisely on time. Delays in railroading are ruinous. All such can be avoided by perfect, honest work. I call upon electric light men to strongly urge this most vital of all considerations upon the railroad world. It is an experience we have gained at a tremendous cost. Is it not to our interests to see that others becoming associated with us do not suffer? Should not all electricians bend all their energies toward making this new and richly promising field a magnificent success? Have you not millions to gain and nothing to lose? Are you ready for it? Are you going to do it?

There are some 1,600 central electric light stations already located throughout the country, and some 425 railroad companies that sooner or later will have to have electric power. Is there any reason why you should not do it? I know of many a station that has to stint and save to tide over the year's dull seasons. You have no day circuits; are held by the sun to one schedule and by the moon to another. The municipal authorities jump at you from behind one post, and your commercial customers from behind the next. Stygian darkness is ever your salvation, and all conditions have to be met and illuminated by your beautiful light. You cannot afford to lose anything. Here is an opportunity for still one more chance at profit. If necessary, enlarge the scope of your charters. It will pay you. Your securities will be worth more, and can be more easily and satisfactorily placed. Railroads have an older and better standing in the financial world and on the money market than electric light companies. Can you afford to let the opportunity go by? From careful research, my own judgment would be that in many cases it would be the company's salvation. I believe the time is rapidly coming when great electric stations, from 5,000 to 20,000 horse-power are to be established. There are plants of from 5,000 to 10,000 horse-power already built for manufacturing purposes. I have been told that the Calumet and

Hecla plant has in the neighborhood of 12,000 horse-power. The New York Steam Heating Company have about 10,000 horse-power of boiler capacity in their stations at Greenwich, Conn.

There are many mills equipped with power of from 1,000 to 5,000 horse-power. Even our ocean steamships are plants of from 8,000 to 12,000 horse-hower. Why cannot electric plants of such power be built? Why are they not? Is there not business enough in lighting, power and railroading? Almost every station I go into the country over is adding to its capacity. "New occasions teach new duties—time makes ancient good uncouth." The horse is uncouth. Electricity is our life.

MR. J. F. MORRISON: Yesterday the Chair appointed Mr. Peck, of Brooklyn, as a member of a committee to present names to this Convention, as candidates for the Executive Committee. Mr. Peck, I understand, has gone home. It is desirable that a full committee should be had. I will, therefore, ask that the Chair appoint somebody else in his place.

THE PRESIDENT: The Chair will appoint Mr. Brown, in the place of Mr. Peck, on that committee. The paper of Mr. Mansfield is before you for discussion.

Mr. Morrison requested that the remaining members of his committee step into the side room, to prepare their report.

MR. MARTIN: I would like to ask the gentleman who made that report what he means by a "day," in running street cars; does he mean 12 hours or 24 hours?

THE PRESIDENT: Will Mr. Mansfield answer the question?

MR. GEORGE W. MANSFIELD: Ordinarily it is a day of 18 hours; that is about the maximum number of hours that a car runs per day.

MR. GEORGE M. PHELPS: I would like to ask Mr. Mansfield another question. He gave us some very interesting and somewhat surprising figures as to the relative magnitude of street car traffic, and of the railroad traffic of the country on steam roads, and most extraordinary and very impressive as to the future of electric railroading. But I would like to ask him if he has made the comparison as to the number of passengers carried per mile between the steam railways and horse cars — the difference between the number of passengers carried per mile?

MR. GEORGE W. MANSFIELD: I attempted to make that division, but could not, because it is such a difficult thing to get at the mileage of horse cars on the various roads in the country

and distances carried. The passengers get on and ride two blocks and then get off. It is such a difficult thing that I could not get any correct figures.

There being no further discussion, this topic was passed, with instructions to the Secretary to spread it upon the minutes.

THE PRESIDENT: We will now hear from Prof. Roberts upon the subject of the Electrical Transmission of Power.

Mr. Benjamin Rhodes announced that there would be a meeting of the Executive Committee at Parlor A of the International Hotel, immediately after adjournment.

ELECTRICAL TRANSMISSION OF POWER.

BY PROF. E. P. ROBERTS.

Mr. Chairman—Members of the National Electric Light Association—Ladies and Gentlemen:

It has been impossible for me to take the time necessary to redeem my promise, made a month ago, to Mr. Garratt, and, therefore, I have no carefully digested paper upon the Electrical Transmission of Power, but merely a few notes arranged from material obtained on Friday last, respecting the development of an interesting constant current dynamo and motor. When I stated to Mr. Brush that my paper for the Convention was not written and requested permission to take some figures from the Brush constant current motor and dynamo then being rushed through the shop for exhibition at this Convention, he courteously acceded it. Upon last Friday morning the apparatus was hastily adjusted, and I was allowed some two hours to obtain such figures as might prove of interest. Although I consider the figures good, better could have been obtained if more time had permitted of closer adjustment of the motor governor, etc.

In order to interest you in the subject, allow me to briefly review the salient points of the largest installation yet erected of this type. The electrical papers gave, last Spring, excellent descriptions of the electrical power plant on the Comstock lode, Virginia City, Nevada, where six 120 horse-power generators operate six 80 horse-power motors. You will remember that each generator drives one motor, that each generator is driven by a Pelton water wheel placed upon the shaft of the dynamo, that the wheels are actuated by water falling 1,680 feet, giving a pressure of 700 lbs. to the square inch. Each wheel is controlled by a governor designed by W. B. Devereaux and his brother, Mr. J. H. Devereaux, of Aspen, Colorado. Mr. J. E. Smith adjusted the governor at the mines. The generators run at 900 revolutions, all are independently driven, as before stated, and the motors turn 850 revolutions per minute, and all drive to the same shaft. An interesting feature is that to this same shaft is geared a surface water wheel and the water which actuates it, after passing it, drops one-third of a mile, and in losing the potential energy it had at the power house it develops dynamic energy

by two transformations back at the same point and adds it to the small amount of dynamic energy it there developed.

The working out of the electrical mechanism to accomplish the above result is of great interest; particularly when we find it so successfully accomplished that orders are being given for similar apparatus for other mines as well as for electrical railroad work and manufactories. A case of poetical justice has occurred in this line. The large Calumet and Hecla Mines being about to erect five of these motors to assist in the production of copper and thus electricity will assist to mine its chief servant—copper; as well as, in many cases, to refine it.

The generator will produce a practically constant current of forty amperes from full load to a short circuit. As factors to produce this result are used compound winding and armature reaction. This introduces as variables in the design series ampere turns, shunt ampere turns, dimensions of armature,

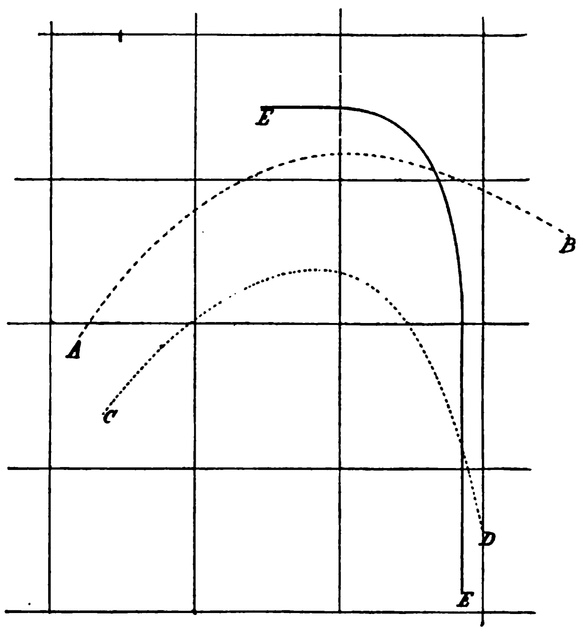

FIG. 1.

shape of pole pieces and length of cut-out segments. Changing any one of these produces a change not only directly due to itself, but also dependent upon the mutual interaction of these numerous factors.

Let us touch upon the subject of compound winding. Most machines have

to be either long or short shunt, but the Brush machine can be intermediate between these if desired, because the action of the armature is the same as if three armatures were revolving connected in series, and we can introduce one series coil anywhere in the circuit and, therefore, make the shunt a "by pass" to the external resistance and armature, or, in the case of a 12 coil machine, to the external resistance plus one-third or two-thirds, or all the armature, or we can make a short shunt and cut it down to one-third or two-thirds the armature.

The compound winding thus possible is evidently very flexible.

The characteristic desired is as shown in Fig. 1, at E, F, and the straight portion will be the working part of the curve. If the machine were of the ordinary type of Gramme ring with small armature magnetism, the curve

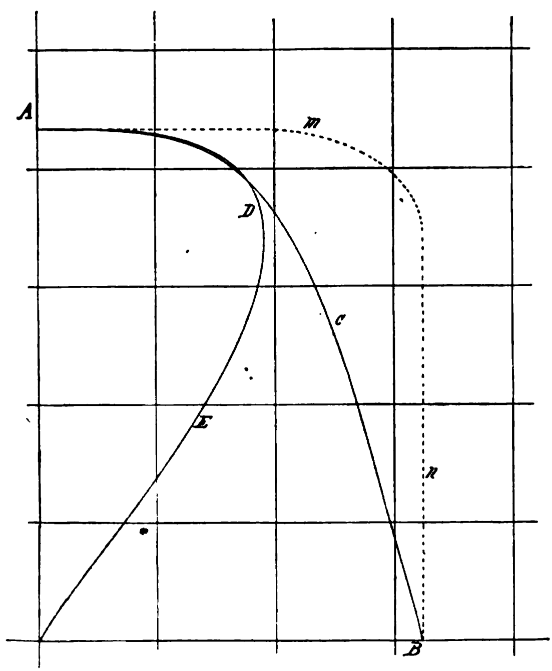

FIG. 2.

would be A, B, and if armature reaction were powerful, it would tend to be as shown in C, D. The reason for this is considered later. If the Brush dynamo be separately excited, the characteristic is like A, C, B, in Fig. 2. If a shunt winding is used, the characteristic is of the type, D, E, F. The combination of these elements must be used to produce the dotted line, M, N. These

curves are modified by the dimension of the iron and the copper in the armature, and this point can be advantageously dwelt upon for a moment.

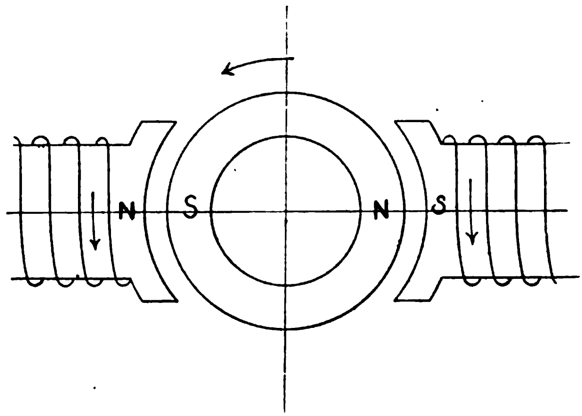

FIG. 3.

The magnetic axis due to the field magnets is as shown in Fig. 3, that due to the armature, as shown in Fig. 4, and that of their resultant as shown in Fig. 5. The line of collection being at right angles to the commutator line, in the apparatus being considered, as an open coil armature is used. The stronger the magnetism due to the armature the greater the distortion of the field and the weaker it becomes. With a constant current through the system it might seem as if no variation in armature reaction were possible. By examination of Fig. 6, we find that although a constant current flows in the out-

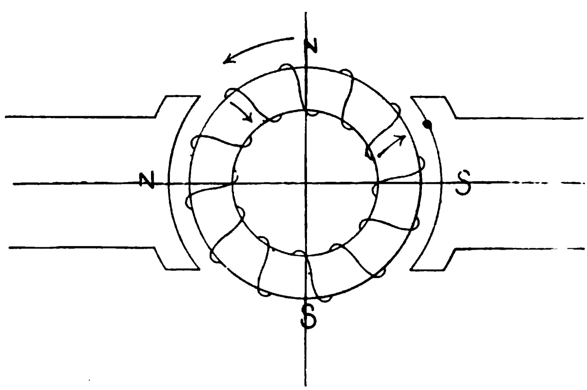

FIG. 4.

side circuit, it varies in the shunt according to the external resistance, and in such portion of the armature as is shunted. If the shunt is a long shunt,

or partially so, the series winding will also be affected. As a segment arrives at the back brush, see Fig. 7, the bobbin connected thereto is approaching the maximum field, and when it reaches the forward brush, both brushes take current from the segment. When the breaking space arrives between the two brushes, the forward brush rests upon the segment above considered, and the bobbin with which it is connected is passing into a weaker field.

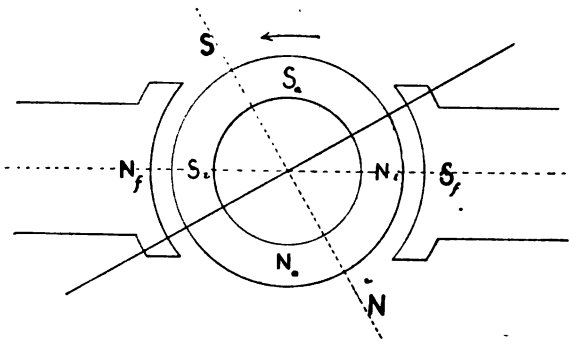

Fig. 5.

We have, however, a self induced current in the bobbin, which desires to discharge itself and takes time so to do—this current will be in the same direction as the armature current. At first, when one brush rests on each segment, the segments are at the same potential. Soon the self-induced current in the front brush has commenced to discharge, the field in which it is revolving having become weaker, and it is time to disconnect the segment.

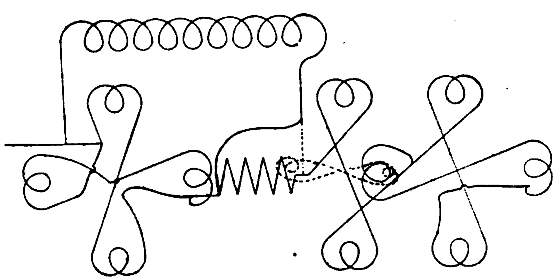

Fig. 6.

Then the breaking space should come into action, or the potential of the back brush will be lowered. The back brush, therefore, carries current but never breaks the circuit, because when it leaves a segment the front brush rests on the same, and the two brushes are connected. As soon as the potential of the segment connected with the front brush drops, it is disconnected. In this way the back brush carries most of the current and does not spark.

The spark upon the front brush is a thin spark without heat, the spark being evidently due to the self-induced currents. To keep this spark at the minimum, an automatic shifting device will be used.

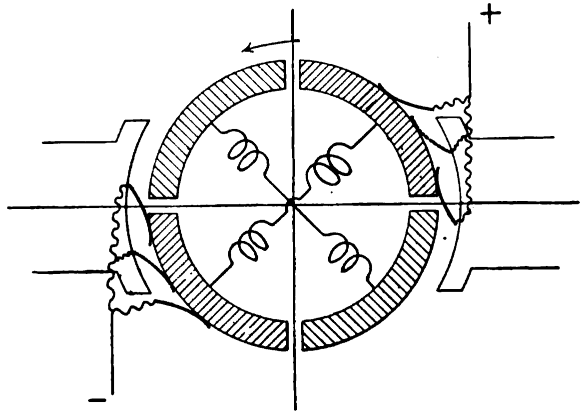

FIG. 7.

The mutual interaction of all these variables, which in their turn are modified by what are constants for any concrete machine, but are variables when the machine is designed, such as shape of poles, etc., is a very interesting study.

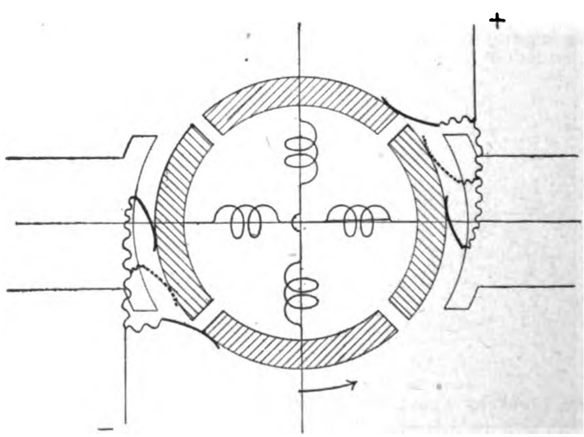

FIG. 8.

The working portion of the characteristics of this dynamo is shown in the diagram, Fig. 9; two tests are shown. The squares represent 100 watts, as the amperes and volts are on the same scale. When the scale for current is five times that for amperes, the result is shown by curve 3.

The motor used in this system is a Brush series wound motor, controlled by a centrifugal governor, which, when the speed changes, shifts the com-

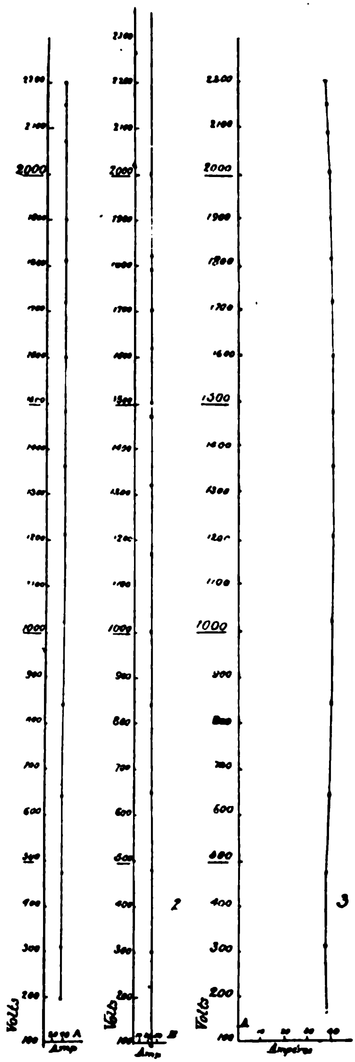

FIG. 9.

mutator into a position calculated to change the magnetic axis of the armature, and assist, more or less, the field magnet strength. This is shown in

Fig. 10. If the load increases, the commutator must move into such a position as to increase the strength of the field. The weights fall in, the commutator moves backward and the resultant line forward. If we bring the S pole of the armature close to the S of the field, the armature would revolve either in one direction or the other, if it received a slight impulse. The more we move the magnetic axis forward, the more work will it develop, until the armature magnetic axis reaches a vertical. It is not necessary for the commutator to shift 90°, as a shifting of the contact line acts, as already shown, to still further shift the field.

The motor tested gave 84 per cent. efficiency at 70 brake horse-power; at 80 horse-power (the limit) it would have been somewhat higher. The efficiency

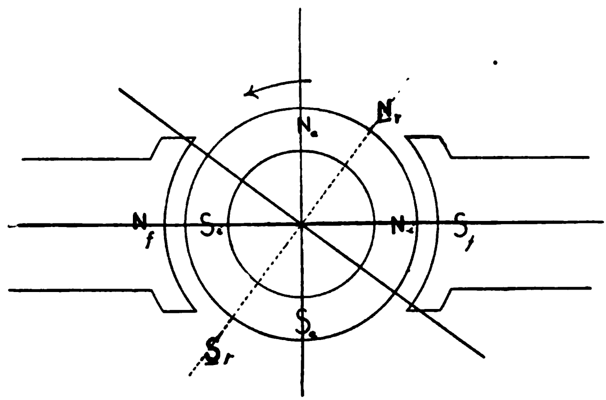

FIG. 10.

must drop at lower powers, as the loss should be about a constant one. I did not have time to obtain figures upon this point.

The dynamo efficiency I cannot give, as I had no dynamometer of sufficient size available. Prof. Sylvanus P. Thompson points out that it is higher than with the motor, as in a motor armature, Foucault currents are assisted by the current in the armature, and in a dynamo the reverse is true.

The striking points in the system are: A generator of great power which cannot be injured by a short circuit. A motor which will not burn up if overloaded, but will stop working. The producer of current, therefore, is not called upon for twice the power represented as being used, and for which the motor was sold, and then have to repair the motor to keep the trade. The system being a series one, every device in the circuit which utilizes the current adds to the efficiency of the system, as it decreases the percentage of loss in the wires.

My thanks are due to Mr. Brush for allowing me to obtain the foregoing figures, to Mr. Pfankuche for his assistance, and to my assistant, Mr. Scheible, for rapidly preparing the diagrams.

THE PRESIDENT: The paper is now before you for discussion. If there are no remarks, the topic will be passed with instructions to the Secretary to spread it upon the minutes.

MR. J. F. MORRISON: Mr. President, your committee beg to make the following report: We recommend Kansas City as the next place of meeting of The National Electric Light Association. We recommend, further, for the officers of the Executive Committee of the Association the following named gentlemen:

G. W. Hart, Kansas City, Mo., Chairman.

L. A. Beebe, Hutchinson, Kan.

J. A. Corby, St. Joseph, Mo.

B. E. Sunny, Chicago, Ill.

S. S. Leonard, Minneapolis, Minn.

C. R. Faben, Toledo, O.

P. H. Alexander, New York, N. Y.

Frank Ridlon, Boston, Mass.

J. F. Morrison, Baltimore, Md.

The vote was unanimous in the committee, except on the last name. (Laughter.)

THE PRESIDENT: Gentlemen, you have before you the report of the committee. What will you do with it?

MR. FRED. H. WHIPPLE: I desire to make an amendment to the report of the committee, if that is in order.

THE PRESIDENT: An amendment to the report of the committee will not be in order.

MR. FRED. H. WHIPPLE: You cannot prevent the motion—it is very important.

THE PRESIDENT: Preliminary to that there should be a motion to adopt.

MR. E. T. LYNCH, JR.: I move that we adopt the report.

THE PRESIDENT: It is moved and seconded that the report of the committee submitted through its chairman, Mr. Morrison, be adopted.

MR. FRED. H. WHIPPLE: I move, as an amendment to that is not in order. Mr. Chairman, I am very sorry that I am obliged to name a place which I hope this Convention will meet in next time, which is not Kansas City. I have the honor, as well as the pleasure, to represent a city something like 12 or 15 hours' ride this side of Kansas City, which is St. Louis. I am authorized

by the Board of Directors of the St. Louis Exposition, to invite this Association to hold their next Convention in their building, in February next. They have unlimited facilities there for the holding of this Convention, and those facilities they offer to this Convention free of cost. The facilities consist of unlimited horse-power, something like 2,000 horse-power, and plenty of space and music halls in which to hold the meetings.

MR. S. A. DUNCAN: As I understand, we are acting upon the report of this committee in regard to officers.

MR. FRED H. WHIPPLE: There has never been a Convention held at which the supply people who were members of the Association have not been glad to pay for their space. We will give you the Convention in St. Louis without expense to any one who attends the Convention, so far as the Convention is concerned. We will pay all bills of the Convention. There will be no bills coming in on you afterwards. We will take care of them all, and give you facilities for making a good time of the occasion. I move to amend the resolution by substituting the word "St. Louis," for "Kansas City."

The motion was seconded.

MR. J. F. MORRISON: It is proper that I, as chairman, should give you the reasons which influenced the committee in their recommendation. Mr. Whipple presented to the committee precisely the statement that he has given you, perhaps fuller, and the inducements to recommend St. Louis were so apparent, that we were compelled to make further inquiry as to what would be the counter-inducements for Kansas City. Kansas City we had thought of for two or three years past, and accepted as the meeting place of the Convention at a date to be named by President Weeks, when the authorities of that city were able to entertain and provide for the comfort and the necessary power and space required for the Convention. St. Louis offered the Exposition Building, probably one of the finest and best equipped establishments of that kind in the country, for holding just such meetings as we anticipate the next meeting of the Association will be. They give you a meeting hall, 2,000 horse-power steam power. They give you every facility for holding the Convention, and absolutely free of cost, either to the Association or to its members who go there to exhibit their wares.

Kansas City presents its case first, in a telegram from the Mayor, addressed to the President of the Association, in which he says:

"I extend through you an invitation to the Convention to hold their next meeting here. Exert every effort to bring the Convention to Kansas City.

"Signed, JOSEPH J. DAVENPORT, Mayor."

The conditions upon which we are invited to Kansas City are similar to those offered by St. Louis. The committee's judgment was influenced by one or two particulars which I will now mention. The hotel rate for this Convention would be from \$2.50 to \$4.00 a day, which is very much lower than the regular rates in these hotels—said to be two of the finest hotels in the United States. One of four large halls, two of which are theatres, two of them halls, capable of accommodating 500 or 600 people comfortably; power sufficient to drive any exhibit may be placed there—not steam power, but electric power, from any class of current or any system that the gentleman may desire to use; constant current, alternating currents, the Edison system, the Brush system, and I don't know what others; but giving you the choice of any system you may desire for your apparatus—all this free of cost.

In the St. Louis matter, we learn that the Exposition Building is some distance from the hotel. At Kansas City, the Exposition Building and the meeting room are directly across from one of the hotels, and diagonally across from the other, so it will be simply crossing the street to obtain access to the room. The proposition made by President Weeks, is to this effect: That one hall shall be taken for the meeting room, and one for the exhibition room. That the exhibition room shall be closed during the meeting hours and open all the rest of the day.

These were the items that influenced the committee in its decision. We do not desire to make any extra recommendation. I have simply called your attention to the fact that Kansas City has been promised this meeting for several years, and the balance of the report is with you.

A MEMBER (from St. Louis, Mo.): As there seems to be some question as to the location, I would like to say a word in favor of St. Louis, and, therefore, will mention the accommodations, etc., of that city. The Southern Hotel is the largest in the country. The rate is there from \$3.00 to \$4.00 per day. What

we can secure in case of a Convention I do do not know, but I do know that during the Gas Convention there, the rate was $3.00 above the second floor, and $4.00 below. The Exposition Building is about six blocks up from Fourth street—no, it is at Fourteenth street, ten blocks—but there are two cable lines making the time in about five minutes. Besides, being one night less ride for Eastern parties, I think more people will come from the East, while more might possibly go to Kansas City from the West. Still, I think, all around, St. Louis being a little more centrally located, with the promise of the Exposition Building, and the fact that this exhibit will be given, I think it will be a very good thing to go to St. Louis.

MR. FRED. H. WHIPPLE: Mr. Chairman, I did not intend to speak twice upon this; but as telegrams are in order, I would like to read one from the President of the Board of Directors of the St. Louis Exposition. Here is the despatch:

"Our Board of Directors have instructed me to invite The National Electric Light Association to hold their February Convention in our building. We have all the necessary facilities for the meeting, and our citizens will extend to the members of such Convention every possible courtesy.

"Signed, SAMUEL M. BERNARD, President."

In relation to the location, let me say that the Exposition Building is just four blocks from the Post Office. Every one who has been to St. Louis and seen the Post Office knows that four blocks away from that building is not very far from the center of civilization. For hotel rates, I am authorized to say that the very lowest hotel rate possible will be given, and that this Convention will be treated as courteously as any Convention ever has been there.

THE PRESIDENT: The question is on the motion of Mr. Lynch to adopt the report of the committee—the question is on the amendment of Mr. Whipple to substitute the name St. Louis in the report of Mr. Morrison. (The Chair calls for the ayes and nays, and upon receiving the same, stated that it was not decided. A rising vote was called for, and there were 14 in favor of the amendment, 13 opposed to it.)

THE SECRETARY: Will the chairman of the Executive Committee check the count.

THE PRESIDENT: The ayes seem to have it.

MR. J. F. MORRISON: I call for a recount of the vote.

MR. FRED. H. WHIPPLE: Mr. Chairman, how many times do we vote after the Chair has decided a thing carried. The decision was that the amendment was carried.

MR. J. F. MORRISON: The gentleman is out of order.

THE PRESIDENT: The gentleman is out of order, as the decision was not rendered. I think the position of the gentleman from Baltimore is correct. (On taking a rising vote the second time, there were counted 19 in favor of the amendment and 11 opposed to it.)

THE PRESIDENT: The ayes have it.

MR. J. F. MORRISON: Now, Mr. President, before a decision is rendered in this case, I want you to make one other decision; that is, whether we are operating under the new Constitution or under the old one.

THE PRESIDENT: Under the new Constitution.

MR. J. F. MORRISON: Then the vote had now is null and void, because the vote is confined to active members.

MR. HENRY A. REED (of New York): Mr. Morrison himself has stated that this Constitution could not go into effect until February next.

MR. J. F. MORRISON I have not. Many points about it do not meet with my approval. This Convention to-day is a Convention of supply men and not of central station men. If you are acting under the new Convention the vote is out of the reach of the central station men and not the supply men. At the Chicago Convention you stood upon the eve of a disruption, and it is for that reason that I have risen here. I came here for a peaceful solution of these questions. These supply men were recognized in the appointment of a Committee for the Revision of the Constitution. That report has been unanimously accepted by this Association. The matter was settled at Chicago. It was referred to the committee, correspondence was carried on, and hundreds of letters have been received from the men who employ gentlemen representing their interests on this floor, to-day, and who, as I understand, were unanimous in their approval of the subject which the Convention recommended, that the voting power of The National Electric Light Association be confined to the central station men and a fair representation given to the supply men. You have received that Constitution,

you adopted it, and you are the men whom it affects. I would not have objected to the supply men as members, I would have taken my chances with you. My relations with the supply men throughout the country have been most friendly. It was only for purposes of selfish ambition of unworthy men who sought to disrupt you. I was willing to take my chances until yesterday. Under the Constitution which you have adopted, there is not a single man who stood up there amongst that gallant band of 19, who has a right to vote on this question. I call for the Chair to make a decision in this case. If he decides that your action is null and void, the vote will have to .be decided by the central station men, and by them a decision must be reached. In presenting this motion I presented it in good faith. I objected to my name going on the Executive Committee. For some reason the Association has given me honors I did not desire. I have striven to discharge my duty always in whatever position I am placed, but when you make laws I insist that you shall abide by the provisions of those laws; when you adopt a Constitution, I insist that you shall live up to that Constitution. You did not even give Mr. Lynch the opportunity of taking up your Constitution, *seriatim*. You could then have made the changes you desire; you could have done the same thing that you are talking about now. You shut the door yourself. After you have made a bargain (and I have known many of you to make bad bargains and stand by them, filling contracts with me for wire after the price had advanced) you should stand by it.

MR. HENRY A. REED: I have no choice at all between these two cities. I would just as leave go to one as to the other. The question that I would like to ask is as to whether the President decides that this Constitution is binding upon this Association at this time, at the moment of the acceptance—not the adoption—where no chance was given for discussion upon this important subject; and if we people are kicked out and told "we will take your brains and your money, but we do not want your vote," I want to know whether that is admitted now, or whether it does not take effect until next year, as Mr. Morrison himself decided yesterday it would?

MR. J. F. MORRISON: Mr. President, allow me to say that we have not kicked the gentlemen out. We have not done anything

of that kind. We all want to keep you in. You have kicked yourselves out, you adopted the Constitution which bars you out.

MR. HENRY A. REED: Excuse me, but there has been no adoption here yet.

MR. J. F. MORRISON: A play upon words, Mr. Reed. You simply took the other word, which means the same thing. I believe that that Constitution was the work of the supply men. Their vote said it was acceptable, and they unanimously adopted or accepted it, and they have made it the fundamental law. The Chair has declared that we are operating under the provisions of this Constitution.

MR. HENRY A. REED: There was a protest. It was ruled out of order.

MR. J. F. MORRISON: There was no discussion, and when the Chair announced that this is the Constitution, there was not a single voice raised against it. There is your Constitution, it is your own work.

THE PRESIDENT: I greatly regret that this discussion has arisen, as I took this whole movement in the kindest spirit, as originating among those members of the Association who are most affected by the proposed action; and the committee who submitted this amendment—three of them belong to that class—the chairman, Dr. Moses, Capt. Candee and Mr. H. D. Stanley, and those sentiments that have been expressed upon the floor of this Convention surprise me and pain me more than I can express. But as I am called upon by the gentleman from Baltimore to decide the point raised by him, I must do what I consider my duty, and I decide that the point raised by him is well taken. This report was submitted to this Convention. An opportunity was given for discussion and amendment. It was moved to accept; this was carried, and the decision of the Chair is that this is the Constitution of The National Electric Light Association. I regret, gentlemen, more than I can express, and I know you will all believe me, that this matter has come up as it has.

MR. FRED. H. WHIPPLE: The subject has become so diversified that I do not know hardly which point to talk on. Mr. Morrison

has hurled some charges over in this direction. I am not connected with either faction. I know nothing about any faction.

MR. J. F. MORRISON: My remarks included Mr. Whipple with the rest of the gentlemen who are not actually engaged in electric station lighting.

MR. FRED. H. WHIPPLE: Now, we have it definitely. Let me say that it was not we who adopted the Constitution; it was not we who had a chance to express our sentiments upon that Constitution. We had no opportunity at all. The attempt was possibly to stifle any discussion at all. That point was carried out very well. But, Mr. Chairman, are we here as a set of fixtures, or are we here for fair play? And shall the sentiments of those that are here be stifled? Irrespective of where this Convention goes, there is a much more important question for this Convention to decide, and that is whether the major portion of the people attending this Convention shall rule, or whether a few men shall? We have taken two votes upon the question of St. Louis, and St. Louis has carried it by a very large majority. Why was not this stated beforehand, so that we would know how we stood? Are we to have one Constitution to-day and another to-morrow? If Kansas City had got the vote, would this question have been raised? I do not think it would. I do not think it is right, gentlemen, and I do not think it is legal the way the Constitution is adopted. I had a very simple amendment to offer this morning. It was an amendment I had spoken of to nobody. It was a very simple thought of my own. I had no opportunity to present the amendment to the people here. Mr. Brown got up and said that his word was "accept" instead of "receive"; but the Chair did not put the motion. I will venture to say, there are not five men in this room who voted for that Constitution; on the other hand, the Constitution under which you were then laboring, stated that a two-thirds vote was necessary to adopt a Constitution.

MR. E. T. LYNCH, JR.: I rise to a point of order. I think this discussion is very much out of order. The Chair was asked to give a ruling in regard to the Constitution, and decided that the new Constitution would hold. My object now is to object against the ruling of the Chair on this particular thing.

MR. FRED. H. WHIPPLE: I entered into a contract with this

Association, last February, by which I paid $20 for certain privileges. What right has this Association to violate that contract?

MR. E. T. LYNCH, JR.: I object to this discussion.

THE PRESIDENT: The point taken by Mr. Lynch is well taken.

MR. J. W. GODFREY (of New York): I voted for it with the understanding that the report was to be received, which was the word that Mr. Brown used.

MR. C. A. BROWN: I used the word "accept," and used it understandingly. The Chairman made the correction and stated the question correctly. I just wish to put Mr. Whipple and the others right.

MR. E. T. LYNCH, JR.: I still rise to a point of order.

MR. J. W. GODFREY: I ask to have the stenographer's notes read. The report was to be received and I ask to have that vote reconsidered.

(Mr. Lynch appealed from the decision of the Chair upon a ruling that the new Constitution takes effect at once. It was seconded by Mr. Blackwell, of Vermont.)

MR. WILLARD L. CANDEE (of New York): I am one of that unfortunate committee being raked over the coals, and, while I think this discussion is entirely out of order, I want to say that every member of the Association has received a circular regarding the By-laws. To these we received answers to 105; 71 in favor of the Constitution adopted. It was not one of our own make, but that of a majority of the letters received. Outside of that, there are no amendments, and nothing additional or new. We thought that we were simply expressing the opinions of the Association and of the supply and central station men.

MR. J. F. MORRISON: I call for the regular order of business, and the vote as provided by the Constitution on the question of the next place of meeting.

MR. E. T. LYNCH, JR.: I object. There is a motion before the house.

THE PRESIDENT: I understood Mr. Lynch to withdraw that motion.

MR. LYNCH: No, sir, I did not withdraw it.

(At this juncture the President requested Mr. J. F. Morrison to take the Chair. After taking the Chair, Mr. Morrison inquired for the gavel, which was handed to him.)

THE CHAIRMAN: What is the business now before this Association?

MR. E. T. LYNCH, JR.: The question is upon a ruling as to whether the new Constitution—if I am wrong I would like to hear from the members of the Association—whether the new Constitution shall be interpreted to affect this Association from the day of its adoption.

THE CHAIRMAN: The appeal from the decision of the Chair is not in order. The Constitution is adopted and is before you for your pleasure. Mr. Secretary, what is the next regular business before the Association?

THE SECRETARY: Mr. Chairman, there is no business in the hands of the Secretary—there is no next order of business, so far as I know.

THE CHAIRMAN: We will proceed then with the adoption of the report of the committee. Are you ready for the question?

(The Chair put the question and declared it carried, and the report adopted. Calls for division.)

THE CHAIRMAN: The decision of the question is made, and no division can be called for after that. As there is no regular business before the Association, there is nothing left to do but to entertain a motion to adjourn.

The motion to adjourn was put, seconded and carried.

The Convention adjourned.

The following report had been adopted by the Executive Committee, but owing to the abrupt adjournment of the Convention, it was not presented. The Secretary has been instructed by the Executive Committee to append it to the official report.

ALLAN V. GARRATT, Secretary and Treasurer.

REPORT OF THE EXECUTIVE COMMITTEE.

Your Executive Committee, appointed at the Chicago Convention, was so scattered throughout the country that it was found too inconvenient and expensive to have meetings of the entire committee; therefore, the various matters of interest were delegated to sub-committees, who have united to make this report.

One of the most important matters before the Committee was the estab-

lishment of a permanent headquarters in the City of New York. The experiment has been tried a few months, and at the Chicago Convention it was ordered to be continued six months more. Your Committee have moved the office from Twenty-third Street to the elegant Telephone Building, No. 18 Cortlandt Street, in the center of the electrical business district, and convenient for both resident and non-resident members.

The work done by the Secretary at this office shows itself in the largely increased membership of the Association, and in the work of the various committees which have reported at this Convention. The Committee have no hesitation in saying that the success of a permanent headquarters has been in advance of their expectations, and earnestly recommend that the New York office be continued.

The volume of proceedings of the Chicago Convention has been made up in better form than heretofore, and the cloth binding changes the pamphlet, which may be thrown into the waste basket, to a book worthy a place in any library. Members have heretofore been limited to a single copy of the proceedings, but your Committee have provided that hereafter further unbound copies, to a reasonable limit, may be supplied to members without charge, and the binding may be added to the current or previous volume at cost.

Your Committee are glad to be able to present a good report as to the finances of the Association. The year 1888 closed with a debt of $1,800. The debt has been entirely wiped out, with the single exception hereinafter referred to. The entire expense of the current year to August 1 has been paid. There are no outstanding bills, and a balance remains in the treasurer's hands of $910. The income of the Association for the calendar year will be over $5,200; the expenses about $1,000 less. So that your Committee can say, with some confidence and much satisfaction, that the Association is in a sound financial condition. There is, as just mentioned, one claim against the Association still unpaid. The amount is $259.60. This was incurred before the appointment of this Committee, therefore, the payment is considered beyond its jurisdiction. There is no doubt whatever that it was incurred for the benefit of the Association, and your Committee recommend that authority be given them for its payment. The preparation for this Convention has been part of the labor of this Committee. The character of the papers presented is such that the report cannot but add to the growing influence of the Association.

The question of exhibit has been a perplexing one. The exhibit of Chicago grew to such large proportions that any exhibit at this Convention was discouraged. It was found, however, that some exhibitors are members and pay dues solely for this purpose, and others have novelties brought out since the last Convention. Therefore, while a large exhibit has not been encouraged, it has been left to the members, with the proviso that there should be no expense in the matter to the Association. This matter of exhibit is one that will call for careful consideration by future committees.

In this connection, your Committee wish to express thanks to the Niagara

Falls Hydraulic Power and Manufacturing Company and the Oneida Community, Limited, for unusual courtesies extended during the Convention.

(Signed) BENJAMIN RHODES, Chairman.

The following resolution has been approved and adopted by the Executive Committee:

We, the undersigned, a sub-committee of the Executive Committee, appointed for the purpose, beg leave to report the following, embodying the views of the Executive Committee:

Whereas, It is extremely important that the United States Census for 1890 should contain a special section for the electrical industry, and that the data for such section should be collected, tabulated and published in a thorough and systematic manner;

Resolved, That The National Electric Light Association, now in Convention, respectfully request the Superintendent of the United States Census for 1890 to provide a section for the electric industry, and they would suggest that Mr. Allen R. Foote, of Cincinnati, Ohio, has proved himself to be well qualified to do this work, and that he would be a proper person to organize and direct it.

(Signed) EDWIN R. WEEKS,
OTTO A. MOSES,
T. CARPENTER SMITH.

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APPENDIX.

DIAGRAMS

Accompanying a Paper by Mr. John T. Henthorne, entitled "New Central Station, Narragansett Electric Lighting Company, Providence, R. I."

See pages 109 to 124, this volume.

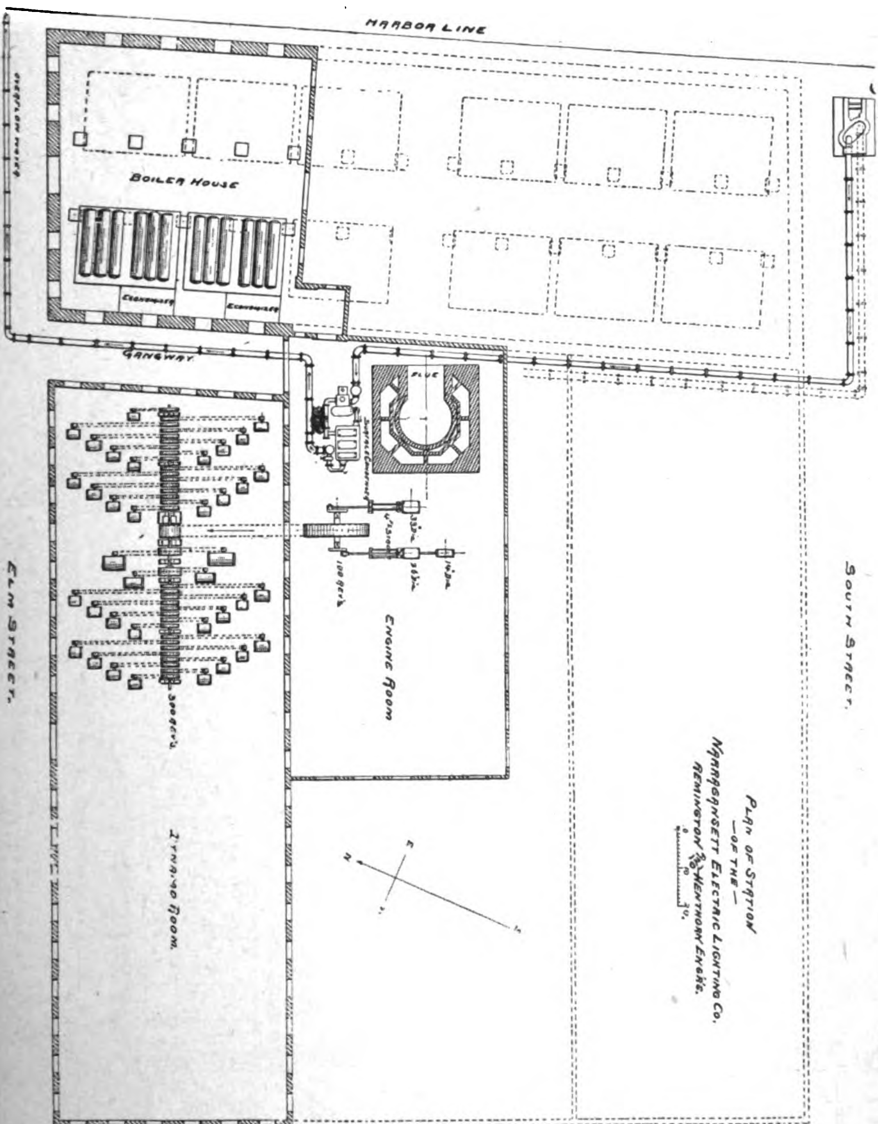


FIG. 1. PLAN OF STATION.

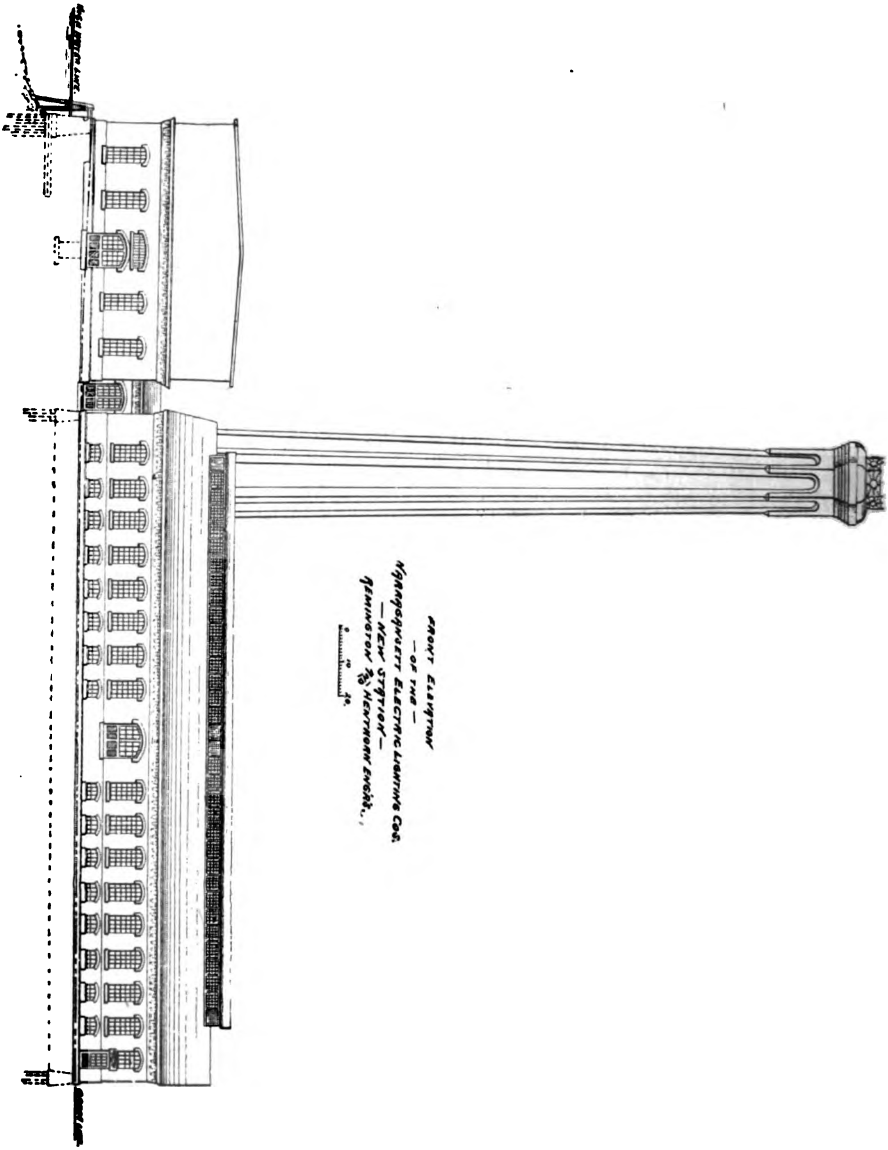


FIG. 2. FRONT ELEVATION OF STATION.

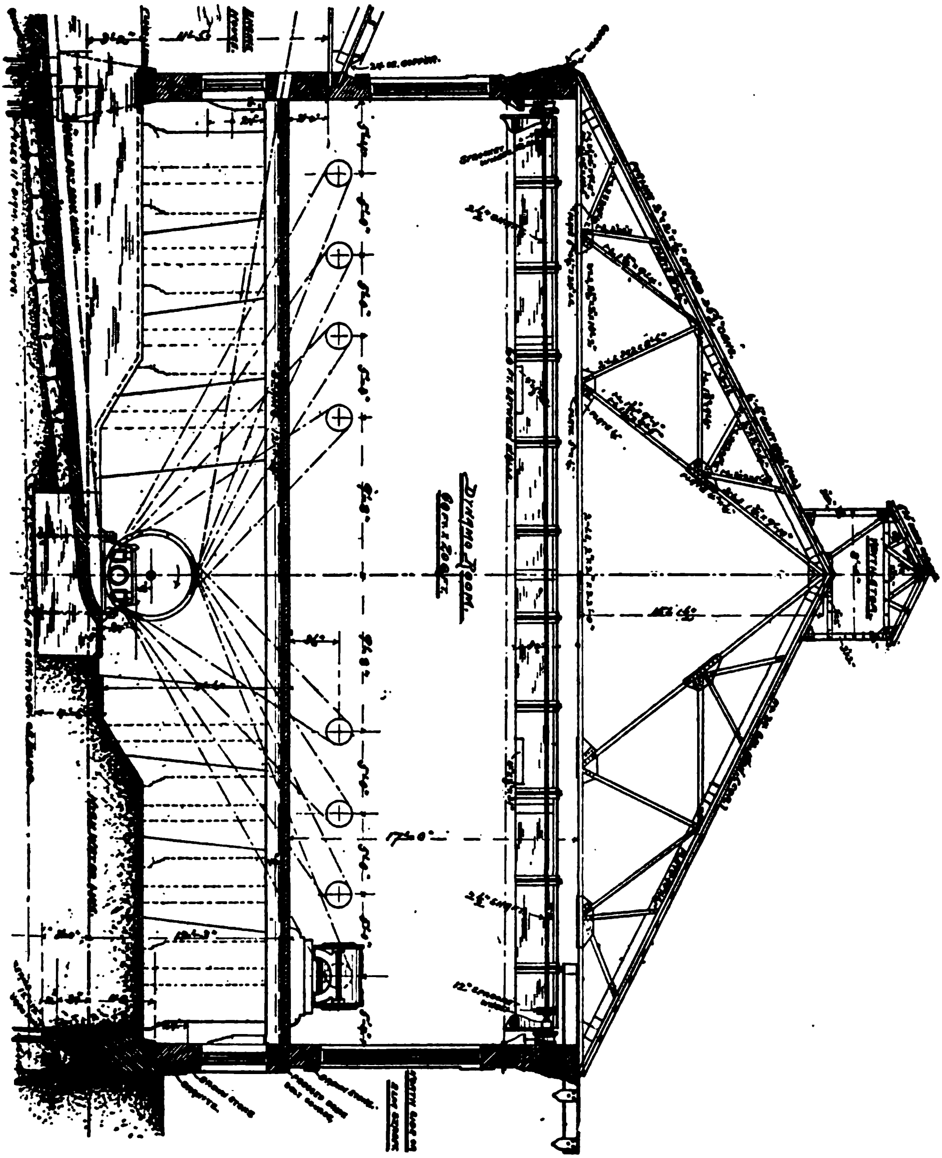


FIG. 3. DYNAMO HOUSE.

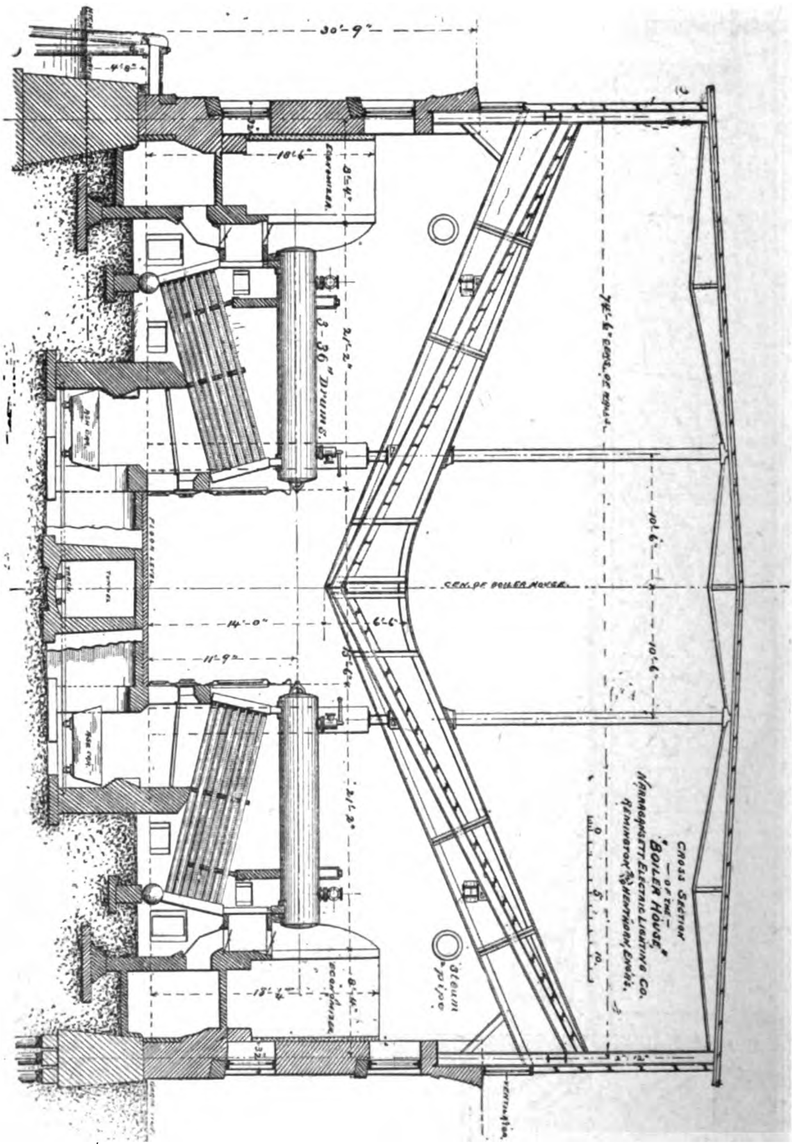


FIG. 4. CROSS SECTION OF BOILER HOUSE.

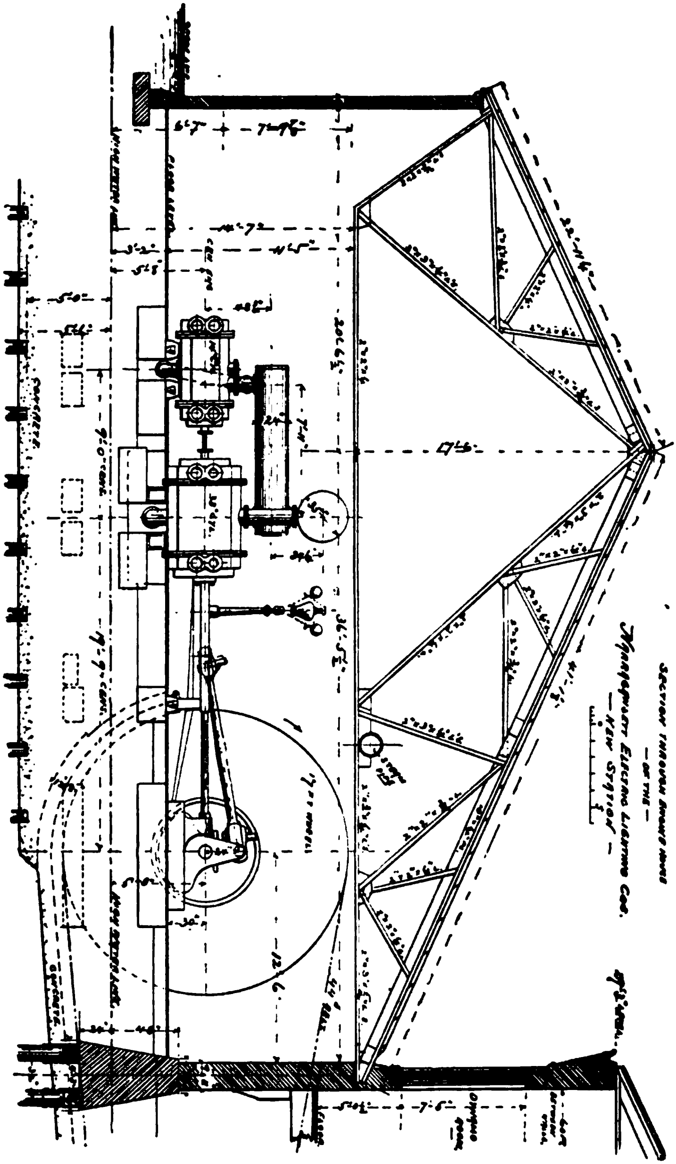


FIG. 5. SECTION THROUGH ENGINE HOUSE.

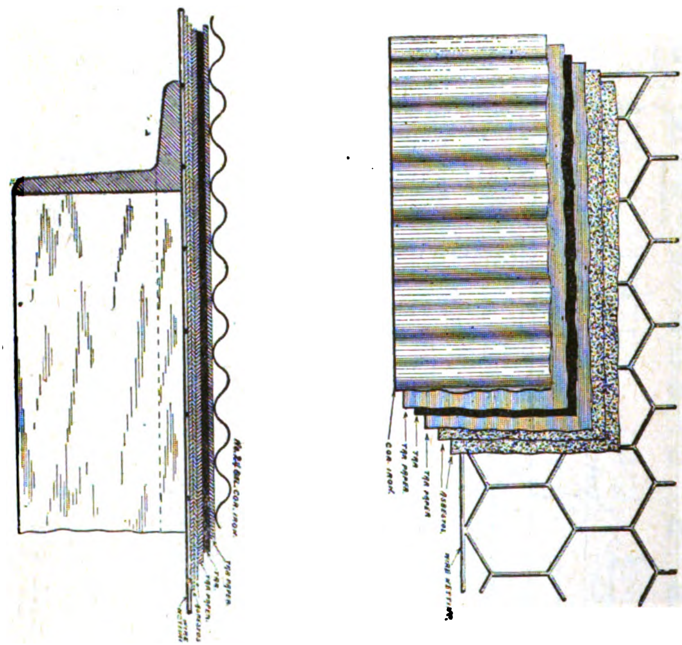


FIG. 6. ROOF COVERING.

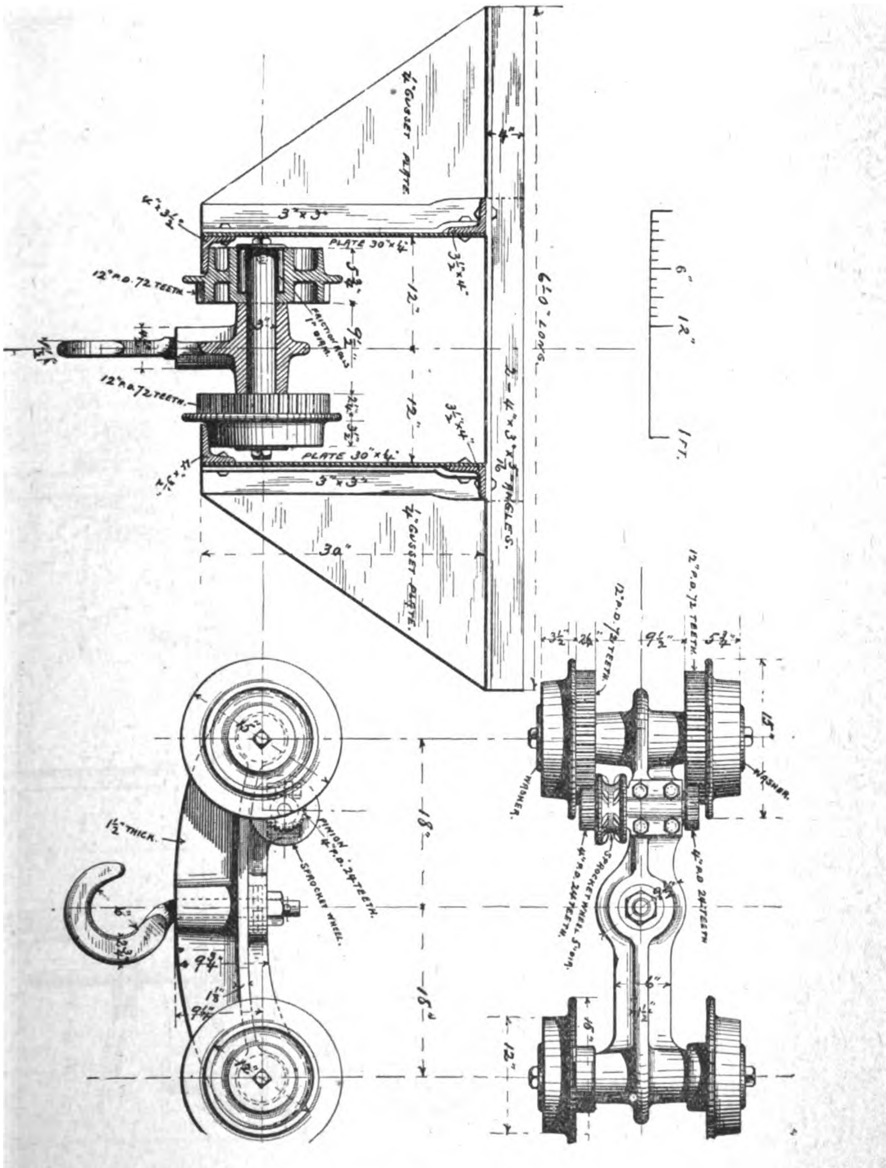


FIG. 8. DETAILS OF CRANE.

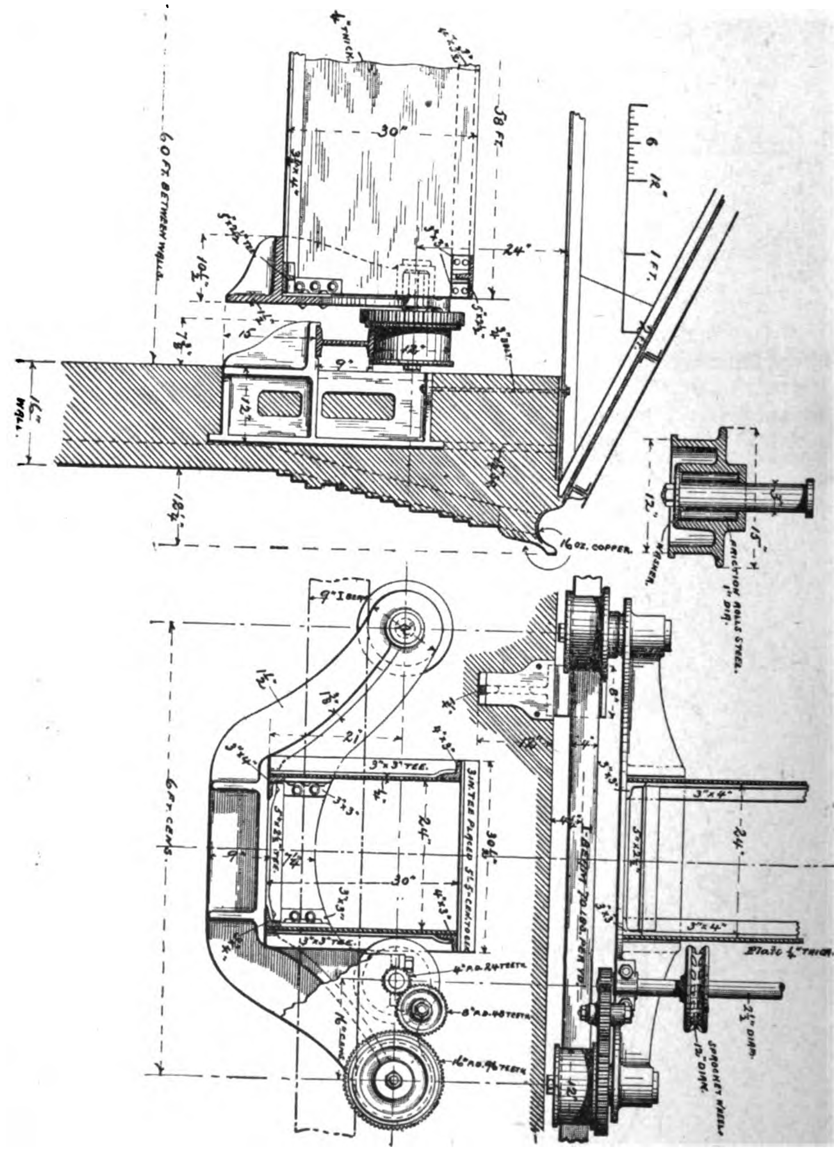


FIG. 9. DETAILS OF CRANE.

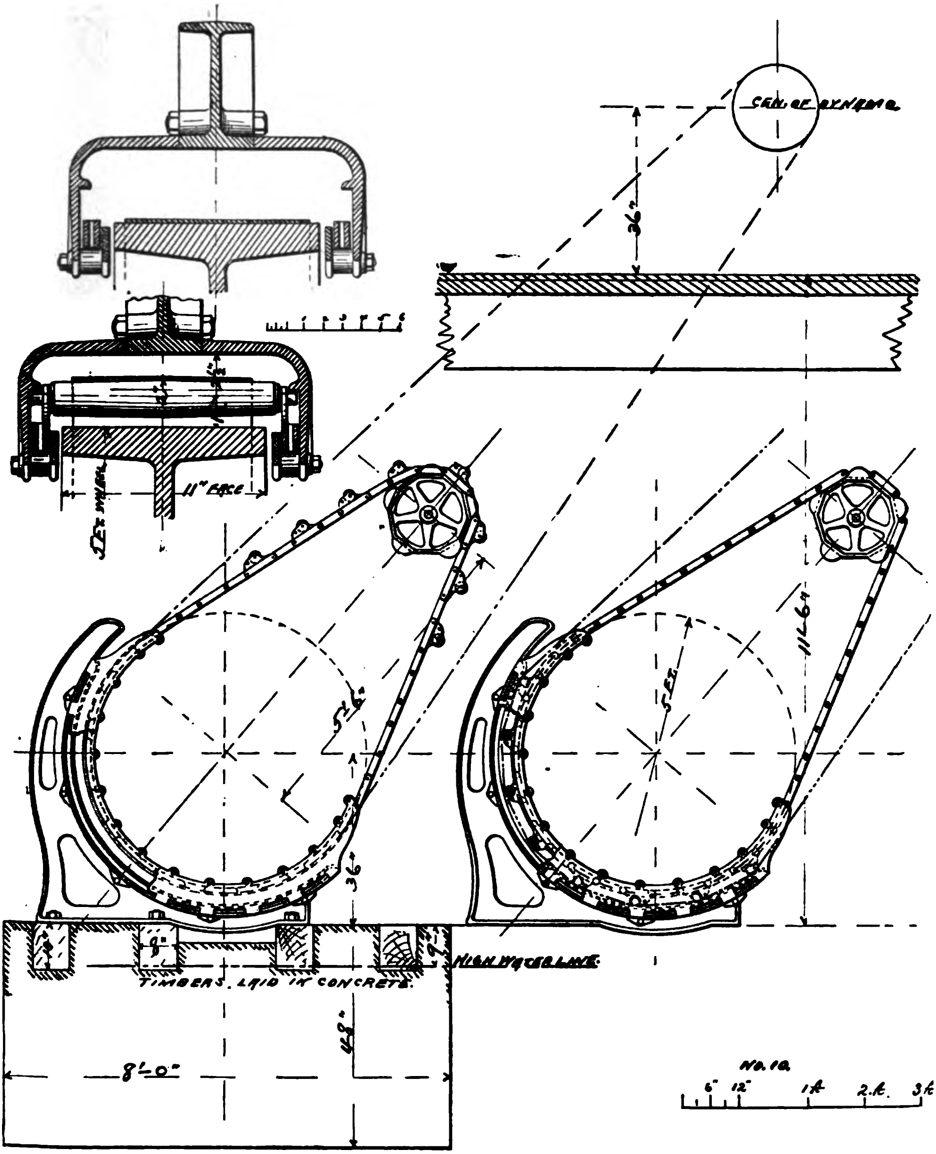


FIG. 10. BELT SHIFTER.

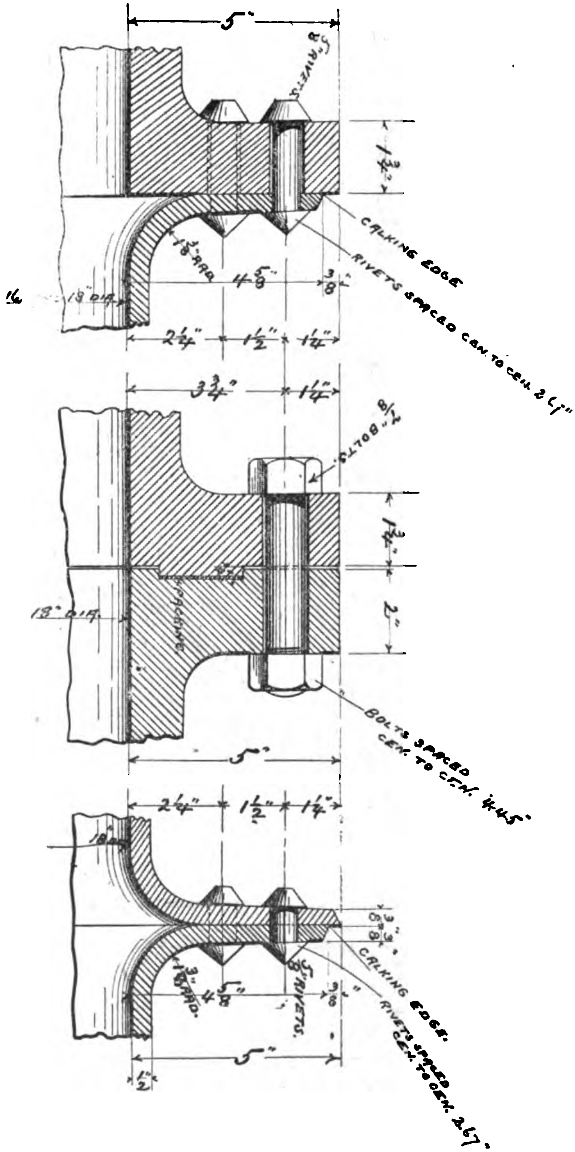
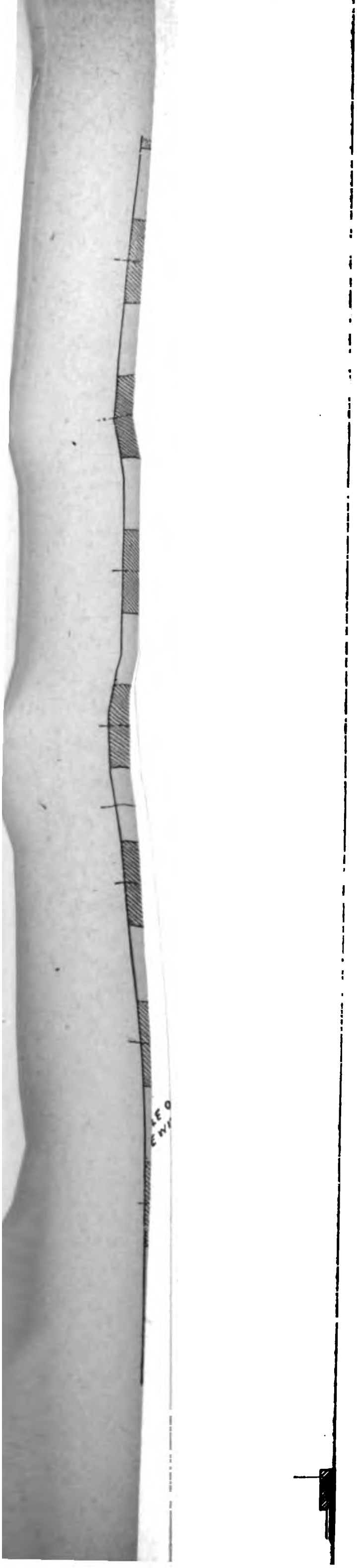


FIG. 11. STEAM PIPE JOINTS.



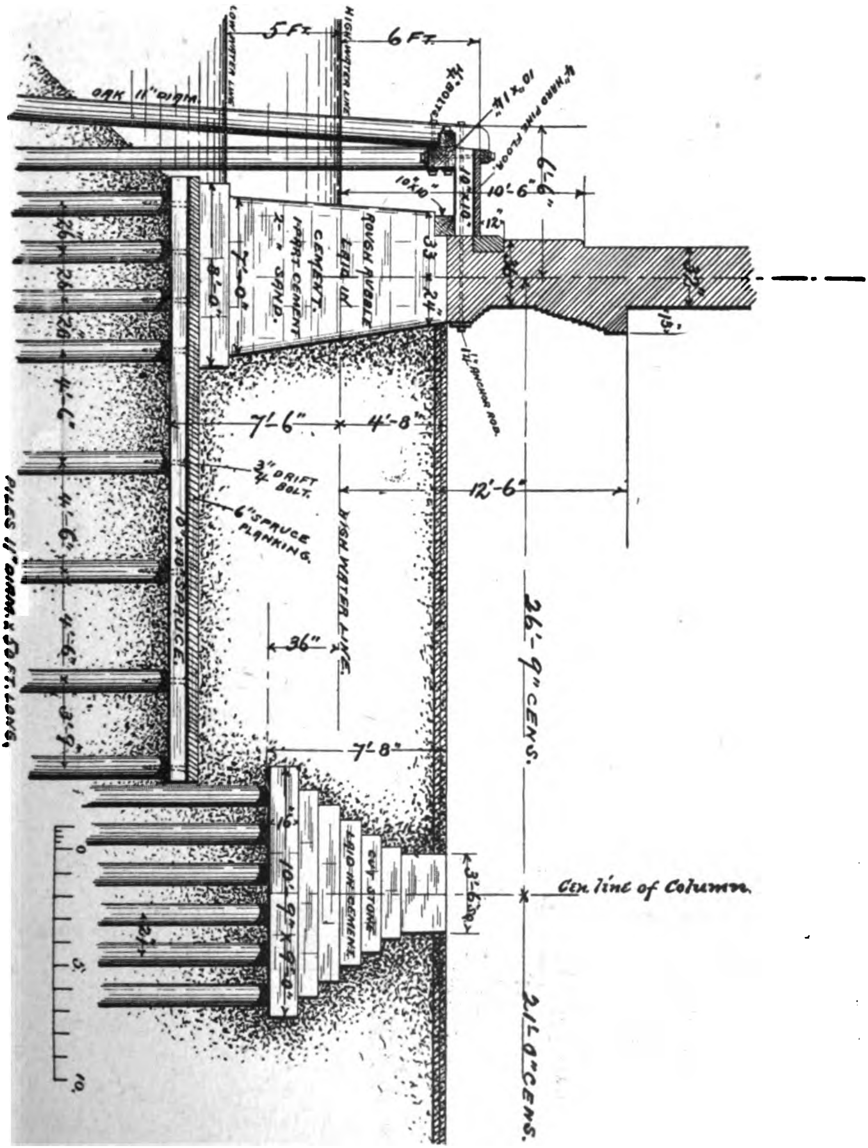


FIG. 12. SEA WALL OF BOILER HOUSE.

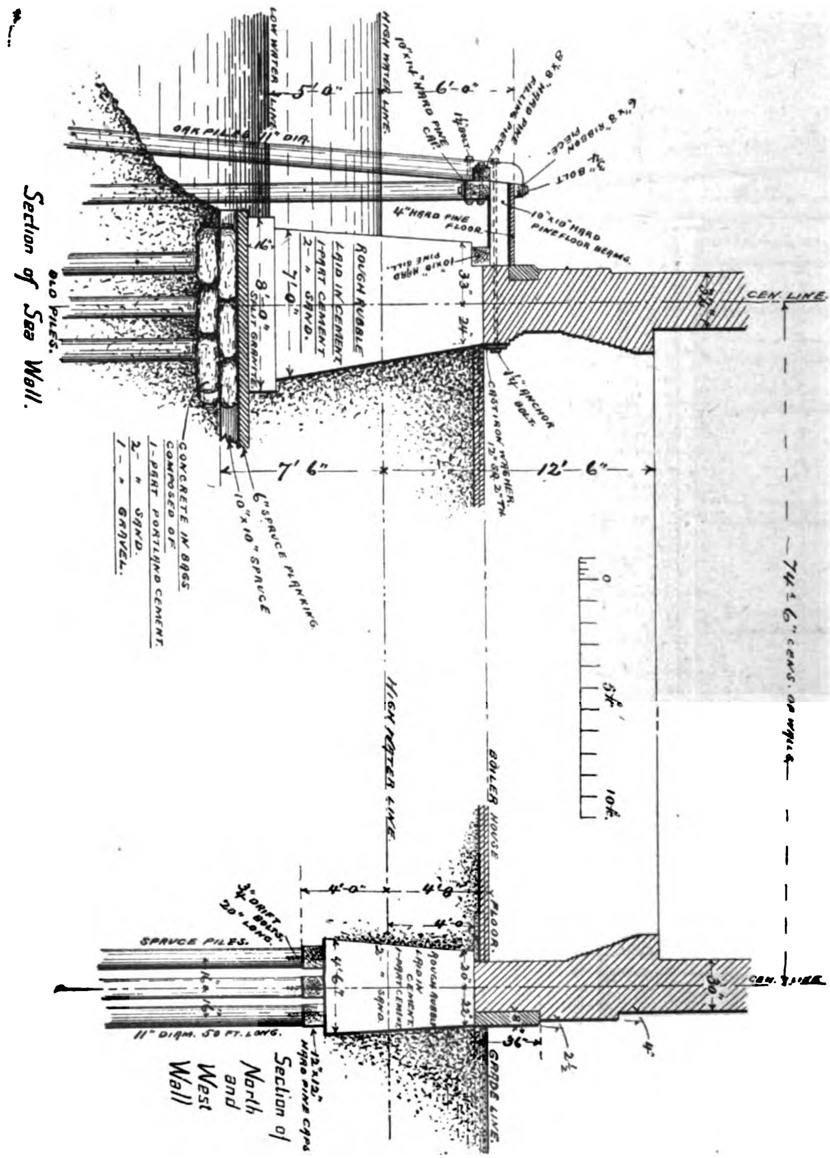


FIG. 14. BOILER HOUSE WALLS.

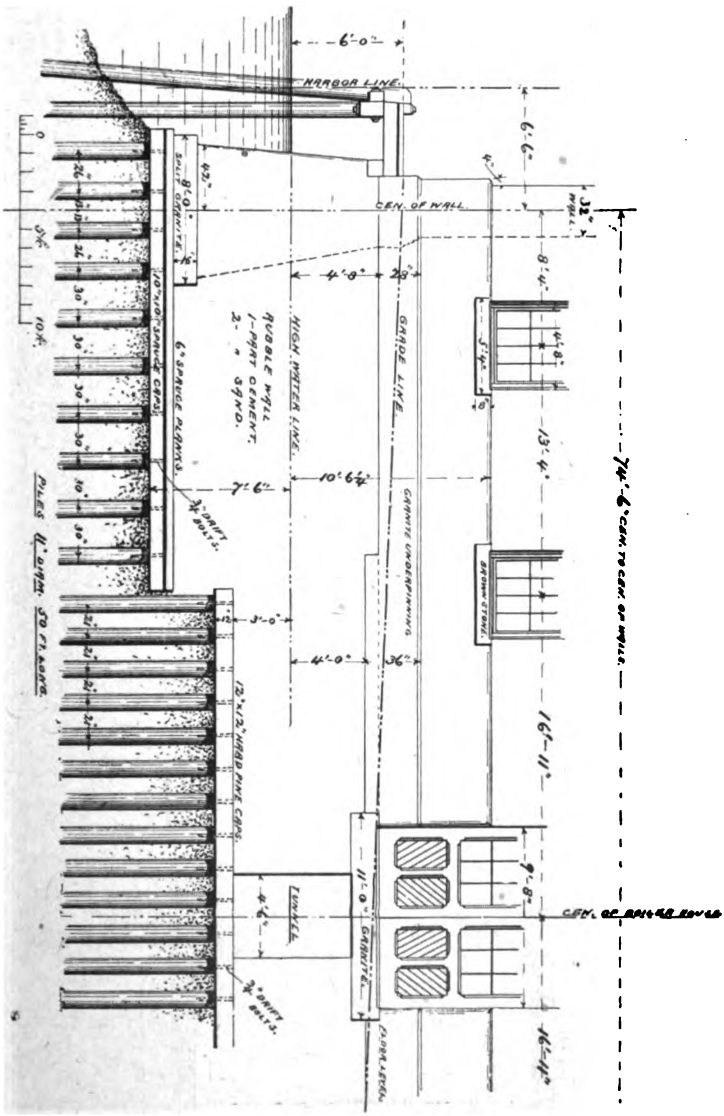


FIG. 15. N. W. CORNER OF BOILER HOUSE WALL.

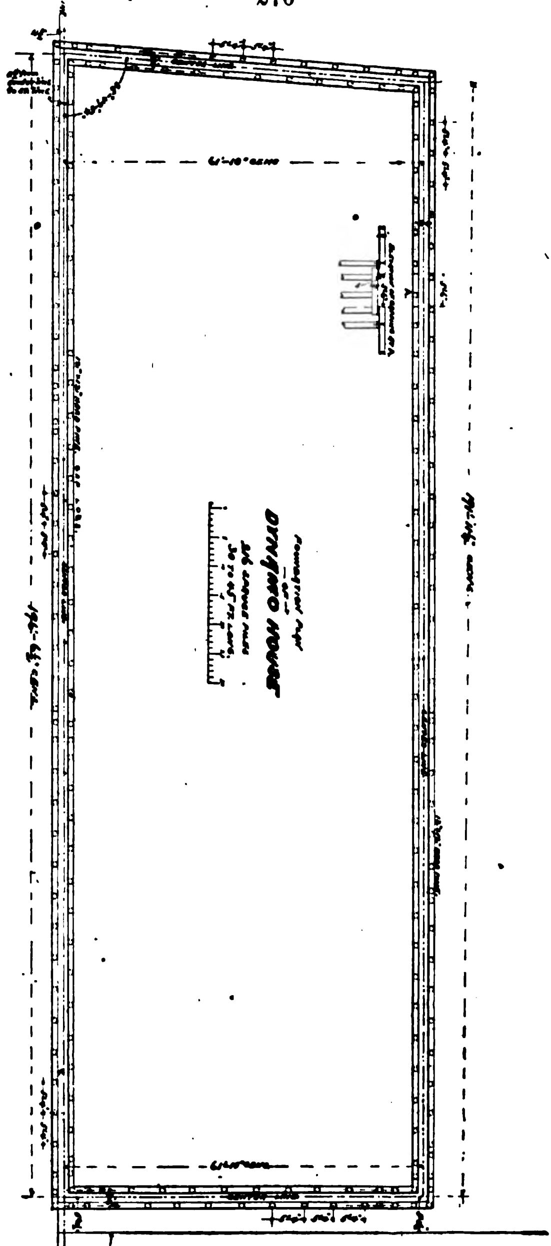


FIG. 16. FOUNDATION PLAN OF DYNAMO HOUSE.

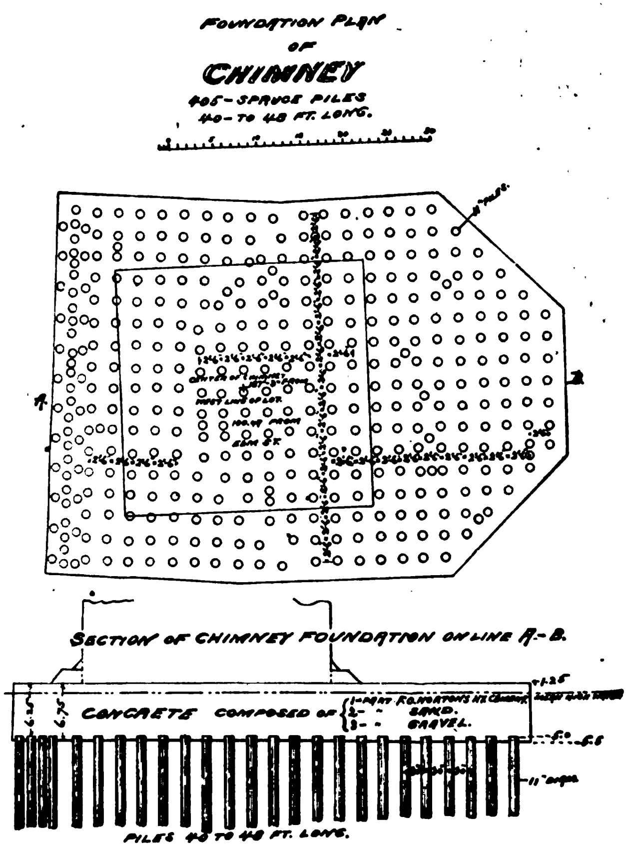


FIG. 18. FOUNDATION PLAN OF CHIMNEY.

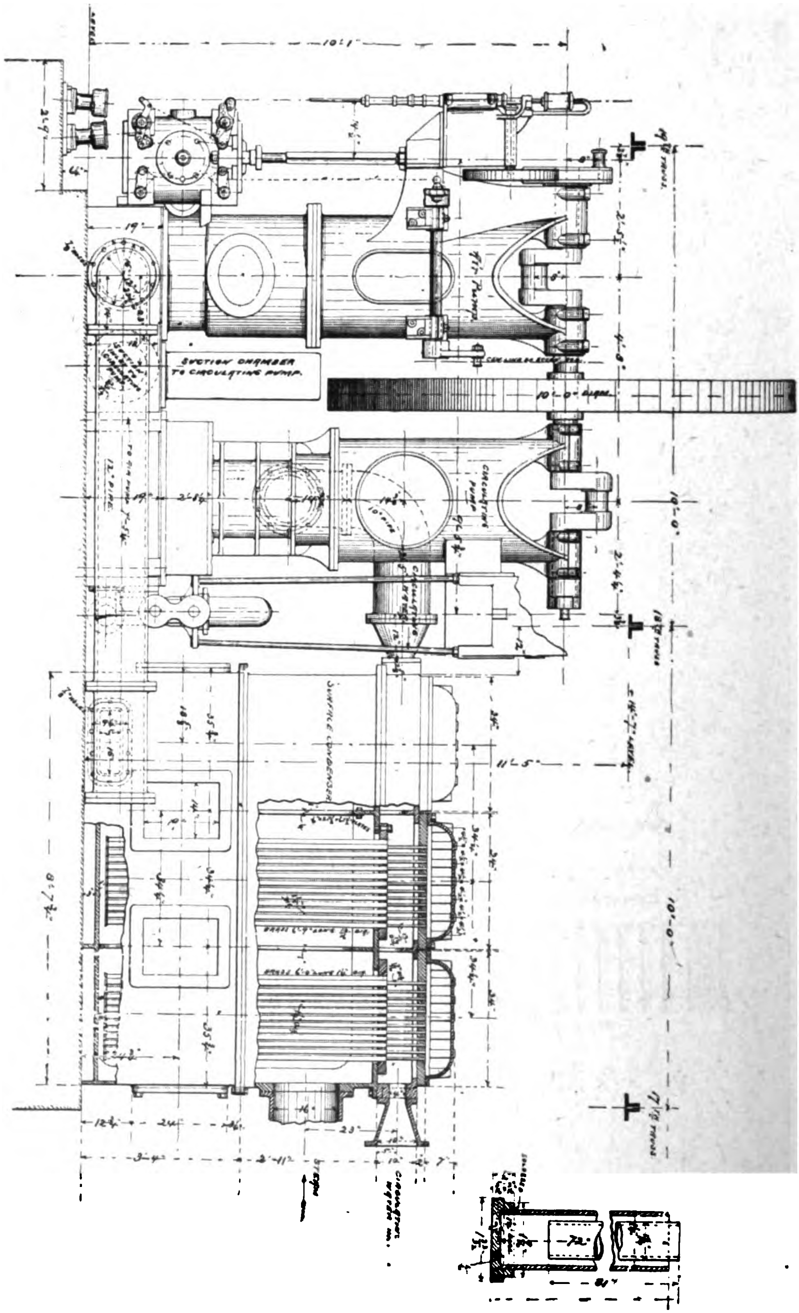


FIG. 19. CONDENSING APPARATUS.

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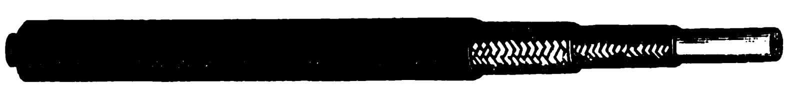

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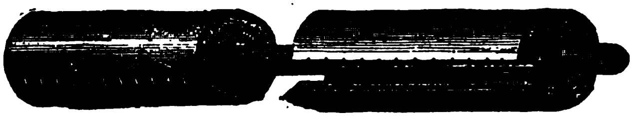

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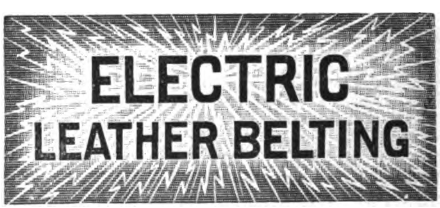

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(2)

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OF THE

NATIONAL ELECTRIC LIGHT

ASSOCIATION,

AT ITS

ELEVENTH CONVENTION.

ANNUAL MEETING,

HELD AT

KANSAS CITY, FEBRUARY 11, 12, 13 AND 14, 1890.

VOLUME VIII.

Headquarters of the Association,

18 CORTLANDT STREET, ROOM 512, NEW YORK CITY.

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JAMES KEMPSTER PRINTING COMPANY,
56 Cedar Street.
1890.

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National Electric Light Association.

ELEVENTH CONVENTION.

ANNUAL MEETING

AT KANSAS CITY, MO.,

February 11th, 12th, 13th and 14th, 1890.

FIRST DAY'S PROCEEDINGS.

The Eleventh Annual Convention of the National Electric Light Association assembled in Coates' Opera House, in Kansas City, Mo., February 11th, 1890, President E. R. Weeks in the Chair, Secretary and Treasurer A. V. Garratt at the Secretary's desk.

The Convention was called to order at 12.30 P. M., by President Weeks, who opened the proceedings with the introduction of the Hon. J. J. Davenport, Mayor of Kansas City, as follows:

Ladies and Gentlemen:

In opening the Eleventh Semi-Annual Convention of the National Electric Light Association, it affords me great pleasure to introduce to you our worthy mayor, the Hon. J. J. Davenport.

Mayor Davenport was received with cheers. When quiet was restored, he delivered the following address of welcome to the Convention:

MAYOR DAVENPORT'S ADDRESS OF WELCOME.

Mr. President, Ladies and Gentlemen of the Convention:

To me has been assigned the pleasant and agreeable duty of welcoming you to our city, where many of the most important and interesting conventions that have been held throughout the

United States during the years 1889 and '90 have sat in deliberation. To none, however, have I extended, in behalf of our citizens, a more cordial and heartfelt greeting than it is now my pleasure and privilege to offer you, whose coming has been a source of pleasant anticipation, mingled, perhaps, with the hope that here in the center of this great American Union, the verge or margin of that borderland of science, which Mr. Thurston so graphically depicts, may some day find its beginning, a land where, it is said, the portrait of the sender of each telegraph dispatch will accompany the message, where submarine and aerial navigation will be carried on successfully by the power derived from stored electricity; where the soft light of the fire-fly or glow-worm will be produced by man, and the direct conversion of heat into electricity will be solved. The result of your deliberations will be anxiously awaited by the whole commercial world, as well as the scientific, because electricity has given an impetus to the former that has driven and impelled it forward with wonderful rapidity and signal success to its present high state of perfection. Its civilizing influences have extended the confines of education, refinement and culture, to the uttermost part of the earth. You, gentlemen, are the exponents of laws which govern one of the most powerful forces of nature, under the action of which, energy becomes appreciable. You teach us that like heat, light or work, it is measureable, and can be produced or converted into other forms of energy. By means of this marvelous agency you have already presented to science most wonderful aids by which she has been able to make visible what has hitherto been invisible, to make audible what has been inaudible, and to discover what has not been dreamed of in the philosophy of mankind, for whether its manifestations be considered under the head of static, galvanic or faradic, it is all electricity—it is all witchcraft, with its future possibilities entirely inconceivable, except to such research as may result from distinguished and able gentlemen, such as compose this assembly. As we hear of these mysterious currents measured in amperes, and of the power by which various bodies resist these currents measured in ohms, we seem to be attaining the condition of life of which Mr. Thurston speaks, or that so cleverly portrayed by Bulwer in his "Coming Race," in which

all are happy and harmonious, seeming to have reached the millennium, evil being held in bondage by the potent "Vril" wand, which gives to all alike motive, defensive and creative power, with also the perfect knowledge of how to use it for the greatest and best good of all. Electricity is our magic "Vril" wand, and you are teaching us its capabilities. Six years ago, it had not been used upon the broad ocean, that difficult and dangerous field of warfare. When the Navy Department fitted out the frigate "Trenton" with an incandescent electric plant, the eyes of the world were upon her, eager to see the mooted question settled as to how the glass bulbs and carbon filaments would bear the firing of the frigate's guns. The three years' successful cruise proved so much to the United States and to those foreign countries who are learning to follow in her footsteps, that now a man-of-war is not equipped without the incandescent lighting plant, and the "arc" for the search light, which reveals not only the dangers of the surface of the mighty ocean, but pierces her briny deeps, detecting death-dealing torpedoes that have been laid for destruction. This faithful servant of man, now not only guards the vessel from the inventions of the enemy, but aims and fires the guns, illuminates the sights that the aim may be sure, discharges torpedoes, measures her speed, is the most successful motor for submarine boats, and renders possible a system of visible telegraphy by which communications may be flashed against the clouds and understood at a distance of 60 miles. We welcome you as true benefactors of mankind, the emancipators of the human race from darkness. What you and those of your profession have accomplished within the past years reflects credit upon your country, borders close upon the miraculous, and entitles you to imperishable honor and renown. I will not detain you in enumerating your achievements, gained by the most faithful and unremitting labor. Cost, or dollars and cents, is the great obstacle in the way of the speedy and universal adoption of many of your most important discoveries and perfected inventions Electricity to-day is at its highest cost, and we look forward to the time when, being cheaper, it will accomplish for humanity all that it now promises. It is estimated that at the beginning of the year 1890, $600,000 was invested in the electrical industry in the United States and that

250,000 persons depended upon it for their means of living; that a million miles of telegraph wires were in operation, enough, it is said, to encircle the globe 40 times; 300,000 telephones were constantly talking, and an average of 1,055,000 messages were sent daily, requiring the use of 170,000 miles of wire. The longest distance over which conversation is maintained is 750 miles, from Portland, Me., to Buffalo, N. Y. Just how many of the musical kind are in use, that Mr. Bellamy speaks of, I do not know. Four hundred miles of electric railway are in active operation in America. The fastest speed attained in the transportation of passengers has been 20 miles an hour. I believe Mr. Weems has quite recently, at Laurel, Md., upon an experimental track, made two miles a minute, or 120 miles an hour. There were no passengers upon that train, however, it being used exclusively for baggage, which is hereafter to be sent in advance. At your annual meeting at Niagara Falls, the statement was made that there were in use in the United States 237,017 arc lamps and 2,704,768 incandescent. I hope that the increase will be so great within the next few years that the various companies will find it possible to furnish light and motive power at much lower rates. Electric light is certainly the only form of artificial illumination not injurious to health, and, therefore, it is our hope that all classes may soon, in consequence of its cheapness, be enabled to enjoy its benefits. The mystery which seemingly surrounds electric service will in time be dissipated, and it will come to be regarded with less suspicion and fear. Perfection cannot be expected in the use and distribution of such force and power immediately. Danger to human life and property interests are questions in which we are all concerned, but it will not do to condemn without comparison and investigation, else we may deprive ourselves of valuable agencies and servants, when to understand is to bring us health, wealth and prosperity. Immense poles, that make unsightly our most beautiful thoroughfares, over which hang a dense mass of wires to obstruct access to our buildings in case of fire, and almost shut out the light of day, will in time disappear. It was necessary that they should precede the subways now coming into use, but not yet, I believe, admitted to be universally successful, though the Bell Telephone Company had, in 1887,

6,030 miles of wire underground; in 1888, 8,009, and in 1889, had increased it to 17,038 miles. Taking into consideration, however, the service performed and work done through the means of this unseen power, it is pleasing to note that the casualties resulting from its use are less than from any other service.

To the future we can only look with wondering eyes and bated breath, and to you as the workers of miracles. May your deliberations, gentlemen, while here, be as harmonious as the laws which govern the marvelous and wonderful philosophy of electricity.

President E. R. Weeks then addressed the Convention, as follows:

PRESIDENT WEEKS' ADDRESS.

Gentlemen:

At our first Convention, held in February, 1885, there were 87 delegates, full of enthusiasm for the good to be accomplished. I believe, gentlemen, that they have not been disappointed in the work of this Association. As one of the original 87, I point with pride to five years of broadening and harmonizing influence; and I believe that every central station, every factory, every supply company in the country, has felt its impulse toward improvement.

To-day, gentlemen, we number 304, representing not only a wider extent of territory than ever before, but all the leading systems of the United States. A more fraternal spirit now prevails between the electric light and power men and our elder brothers of the telegraph and telephone interests, a pleasant proof of which has been given by the hearty co-operation of their representatives in this city, in preparing for the entertainment of the Convention.

The past work of the Association speaks for itself; but our number has so increased, and our sphere of usefulness has so advanced, that we must look for work of a better character than was possible in earlier days, when most of our members were new to the duties which they had undertaken. We now need work of more direct practical value to central station men, and theoretical work of a higher grade than that of the past, good as

that has been. With this in view, we have endeavored to prepare a programme of such importance, both practically and theoretically, that you will find it good to be here.

The Committee on State and Municipal Legislation will report the organization of State Associations with a view to developing among legislators a full appreciation of the importance and needs of the electrical industries, and to present these industries in their true light. The urgent need is for organization along the lines of legislation and popular education. This can be best accomplished by State Associations, whose conventions could advantageously take the place of the semi-annual meetings of this Association. Ten of these State Associations have been formed, and I hope that before the close of this Convention steps will be taken toward the organization of many more.

The increasing interest in railroad work and the immense field for future development in the motor department, will render especially pertinent the discussion by Mr. Sprague, and also the work of the Committee on Standardization of Potential on Electric Street Railways, the report of which will be submitted through its chairman, Mr. Lynch.

As the growth of our industry must be chiefly in the direction of incandescent light and power, the discussion to be presented by Mr. Field is of the greatest importance both to central station men and to all who desire electric service in their homes.

The watchwords of the future are certainly economy of fuel and perfect insulation, and, while there may be improvements in designs for apparatus and in methods and means of distribution, and while we still hope for the direct conversion of the energy of coal, the advance of the immediate future should be in the direction of economizing present waste, rather than in the discovery of new facts or principles. Americans are proverbially prodigal, and there is an absolute and growing need that waste and loss should be arrested. While the demand for the necessary elements is increasing with the population, the supply of many of those elements is steadily diminishing. Messrs. Babcock and Sickles will doubtless point out lines of economy in the department of steam engineering, and Mr. Smith will present for our consideration another phase of the same question, "A

Universal System of Central Station Accounts." The many problems arising in the electrical and mechanical departments of the operation of central stations have left this question to general neglect. But now that we are becoming passably familiar with the tricks of our apparatus, attention is more and more directed to data for comparison, with a view to economic methods.

The topic of the hour is certainly safety. It would seem that, in view of the relatively small number of serious accidents connected with electrical industries, we have grounds for some impatience with the present outcry against electricity as a dangerous servant. It is true that compared with those which have accompanied the introduction and use of steam and gas, the number of accidents in the use of electrical apparatus is very small. But in this age, comparative rates will not be accepted as answers; the people have a right to demand that devices for public safety keep pace with development in other directions. The discussions of Prof. Thomson and Messrs. Haskins and Harber will present this current topic in its various phases. I trust that each speaker will enforce the importance of good construction and maintenance on the part of producers; and proper inspection on the part of the municipality.

It is hoped that the Committee on Underground Conduits and Conductors will be able to report some facts regarding the actual operation of high pressure currents underground. Thus far, discussion of this topic abounds in theory and speculation, but contains little experience.

During the past 12 months there has not only been a greatly increased activity in the electrical industries abroad, but many millions of foreign money have been invested in the electrical properties of America. It is also worthy of note that our brethren in Great Britain have set the example of adjusting differences amicably, instead of carrying litigation to the court of last resort. Such a policy in America would not only have saved hundreds of thousands of dollars now charged to profit and loss, but would have greatly enhanced the value of electrical securities.

The past year has furnished instances in which the value of local electrical properties has been greatly depreciated through

the invasions of territory already fully occupied. This policy is shortsighted. Prices in most cities are fair and just, both to consumer and producer. To depreciate them, will not only ruin the business of pioneer companies who have invested large sums, and borne the brunt of introducing a new and valuable industry, but cannot fail to result in great loss to the invader.

Although electric lighting in this country has seemed to receive a check, a look ahead would not be discouraging. The law that "action and reaction are equal and in opposite directions" applies not only to mechanics, but to public opinion. As America is the birthplace of the commercially successful electric light, and as Americans are the foremost people of the world to recognize improvements, we may well believe that with proper attention on our part to our duties to the public, the present popular and largely sensational agitation against us will give place to a feeling of confidence. In the meantime, let the outcry teach its proper lesson to all engaged in the electrical business. (Applause.)

Secretary Garratt called the roll of the Association, and the responses indicated the presence of somewhat more than 100 members.

THE CHAIR: The next business in order is the reading of the report of the Secretary and Treasurer. Before that is done, however, it may be well to say that it is designed to hold a very brief session to-day, and adjourn in plenty of time for lunch. (Applause and laughter.)

Secretary Garratt presented his report, as follows:

REPORT OF THE TREASURER AND SECRETARY OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, DECEMBER 31ST, 1889.

PRESENTED AT THE KANSAS CITY CONVENTION, FEBRUARY 11–14, 1890.

Balance from account rendered July 31st, 1889, at Niagara Falls	$1,096 93	
Dues from 51 members	1,020 00	
	$2,116 93	
Expenditures as per accompanying vouchers, numbered 87 to 112, inclusive		$1,506 76
Balance, cash on hand, December 31st, 1889		610 17
		$2,116 93

The indebtedness of the Association is an unpaid bill of..		$259 60
The above expenditure of $1,506.76 for the six months ending Dec. 31st, 1889, may be classified as follows:		
Postage..		48 52
Stationery and printing..................................		143 90
Official Stenographer....................................		85 37
Rent of office...		50 00
Advertising..		46 99
National Committee on State and Municipal Legislation..		98 65
Salary of Treasurer and Secretary........................		999 96
Expenses not specified above.............................		33 37
		$1,506 76
The total receipts for the year 1889 have been, including the balance from the previous account..............	$5,845 55	
Total expenses for year of 1889..........................		$5,235 38
Balance, cash on hand, December 31st, 1889.............		610 17
		$5,845 55
The expenditures of the year 1889 may be classified as follows:		
Old bills incurred previous to 1889......................		$1,483 82
Salary of Secretary and Treasurer, 12 months............		1,999 92
Clerk hire...		40 00
Postage..		176 48
Printing and stationery..................................		712 19
Official stenographic reports............................		246 62
Rent of office...		207 50
Advertising in electrical journals.......................		101 99
National Committee on State and Municipal Legislation..		98 65
Not otherwise specified above..........................		168 21
		$5,235 38
The net income for 1889 was..............................	$5,545 82	
The running expenses for 1889 were.......................		$3,751 56
Excess of net income over running expenses...............		1,794 26
		$5,545 82

MEMBERSHIP.

Total number of members July 31st, 1889....................................	251
Members added between July 31st and December 31st, 1889.............	21
Total..	272
Members resigned between July 31st and December 31st, 1889..........	13
Making total membership Dec. 31st, 1889................	259

On motion, the Secretary and Treasurer's report was accepted.

Secretary Garratt read communications from the following:

A communication from the Commercial Club, of Kansas City, tendering the Convention a reception. The courtesy of the Commercial Club was accepted with a vote of thanks.

The Secretary also read a communication from W. H. Briethaupt, President of the Engineers' Club, of Kansas City, tendering the privileges of the club room of that club to the National Electric Light Association during the Convention.

Also a communication from J. H. Veitch, general agent of the Chicago, Milwaukee and St. Paul Railway, extending an invitation to the members of the Association to visit the great health resort of Missouri—Excelsior Springs—and offering a train for that purpose on Wednesday, the 12th, at any hour which might suit the convenience of the Association. A communication from Howard M. Holden, president of the Excelsior Springs Company, extending an invitation to the same effect, was also read.

The Secretary also read a communication from William Wiley Smith, Secretary and Superintendent of the Missouri and Kansas Telephone Company, of Kansas City, extending congratulations to the Association and offering telephonic facilities between the halls and the central office, and also extending to the delegates an invitation to visit the central office of the Telephone Company, in which, as was stated, nearly 2,600 wires were handled in one room, and over 32,000 calls per day were made.

MR. A. J. DE CAMP: Mr. Chairman, I move you that the invitations just read be accepted, and the President be authorized to arrange a time satisfactory to all parties.

MR. DEGENHARDT: I move, as an amendment, Mr. President, that a vote of thanks of this Association be tendered for the courteous invitations that have been received. (Carried unanimously.)

SECRETARY GARRATT: Mr. President, there are two more letters that have been received, one from the National Home for Disabled Volunteer Soldiers, at Leavenworth, Kansas, which is as follows:

LEAVENWORTH, KANSAS, February 8th, 1890.

President National Electric Light Association,
Kansas City, Mo.

DEAR SIR:

I have the honor herewith to extend an invitation for the Association, of which you have the distinction of being the head, to visit the National Military Home for D. V. S.

I am sure I can make your stay pleasant. Kindly notify me which day of your session will be most convenient for you. My time is at your disposal.

If you accept, please time your departure so that you may arrive by 11.30 A. M.

Very respectfully,

ANDREW J. SMITH, Governor.

THE CHAIR: What is the pleasure of the Convention?

MR. DE CAMP: I move the invitation be received with thanks. (Seconded and carried.)

SECRETARY GARRATT: There has also been received an invitation from Mr. George W. Warder, as follows:

KANSAS CITY, MO., February 11th, 1890.

Hon. E. R. Weeks,
President National Electric Light Association.

DEAR SIR:

It gives me pleasure to tender to your Association a reception, to be held at the Warder Grand Opera House, on Friday evening, February 14th, if agreeable to your Association.

Should this invitation be accepted, I would be pleased to have your response (or meet any committee you may see fit to appoint) as soon as possible.

Very respectfully yours,

GEORGE W. WARDER.

MR. DE CAMP: Mr. Chairman, I move that these two last invitations be referred to the Executive Committee, to take such action upon them as in their wisdom may seem proper. (Motion seconded. Carried and so ordered.)

Secretary Garratt then announced a meeting of members from Missouri, for the purpose of forming a State Association, and gave other notices.

THE PRESIDENT: Gentlemen of the Convention, owing to the occupation of this house to-morrow for a matinee, our session to-morrow will be held in the Music Hall, just across the street and a little way down. I hope that when we adjourn this afternoon, we will adjourn to an early hour at that hall, as we have a long and interesting programme to get through with at that time.

I would say that the Reception Committee would be glad to see as many as would like to go with them this afternoon, to make the rounds of the city by means of cable cars and elevated roads, and to have all such signify to them their disposition to do so, shortly after lunch. It would be well for you to get together as soon as possible after three o'clock.

Before adjourning, I would also remind the Association of the reception at the Commercial Club this evening at eight o'clock. This reception will be informal and you are all cordially invited. A motion to adjourn will now be in order.

MR. FABEN: Mr. President, I suggest that we meet early to-morrow, and for that purpose, I move you that we meet here promptly at nine in the morning, and at 1.30 at Music Hall.

THE PRESIDENT: I think the motion of Mr. Faben is a very pertinent one. As I said, we have a long and attractive programme.

MR. SMITH: Do not fail, Mr. Chairman, to make the announcement concerning the photograph.

THE PRESIDENT: Mr. W. W. Smith requests me to state that parties desire to take a photograph of the Opera House and of the members of this Convention. The photographers are ready just outside of the building, and if you will all assemble there after adjournment, the object can be accomplished in a moment.

MR. DEGENHARDT: Mr. Chairman and gentlemen, I desire to call your attention to the death of Mr. C. McIntire, which seems to have been overlooked. I feel that the Association should take some action in regard to the matter and know they will be glad to pass a suitable resolution. I move you, sir, that the Chair appoint a committee of three to draft suitable resolutions concerning the death of our member, Mr. McIntire.

SECRETARY GARRATT: May I also make a suggestion? Miles W. Goodyear, of New York, a member of this Association, has also died during the past year, and I would suggest as an amendment that the resolutions be made to embrace his name.

I had no knowledge of the death of Mr. McIntire, or, of course, his name would not have appeared upon the roll as an active member.

MR. DEGENHARDT: I accept the amendment to the motion offered by Secretary Garratt. (Seconded. Carried.)

THE PRESIDENT: I will appoint as members of the committee to draft appropriate resolutions, Mr. Degenhardt, Mr. Candee and Secretary Garratt.

On motion, the Convention adjourned to meet at the Music Hall, at nine o'clock, A. M., February 12th, 1890.

SECOND DAY'S PROCEEDINGS.

FEBRUARY 12TH, 1890, MORNING SESSION.

The Convention was called to order in Music Hall, at nine o'clock, A. M., President Weeks in the Chair, Secretary A. V. Garratt at the Secretary's desk.

The Chair announced that the train for the excursion to Excelsior Springs would start at 3.30 o'clock, P. M., and members were advised to be on hand.

Secretary Garratt read the following communication:

METROPOLITAN STREET RAILWAY CO., GEN. MANAGER'S OFFICE,
KANSAS CITY, MO., Feb. 11th, 1890.

To the President and Members of the National Electric Light Association,
Kansas City, Missouri:

The Metropolitan Street Railway Company respectfully offers to the members of your Association the privilege of riding free over its lines, and orders have been issued to conductors to honor the badges worn by members accordingly.

Your members are cordially invited to take a trip over the Armourdale Electric Line at their convenience. Hoping that we may be given notice of your pleasure in the matter so that we may be able to make special arrangements for your accommodation, I have the honor to be,

Yours, respectfully,
R. J. MCCARTHY,
General Manager.

On motion, the courtesy was accepted, and the communication was ordered spread upon the minutes of the Convention.

Secretary Garratt read the following:

THE MIDLAND, PARLOR S, KANSAS CITY, MO., February 11, 1890.

The National Electric Light Association.

The following resolution has been passed by the Missouri State Association of Architects, now in session in Parlor S, Midland Hotel:

Resolved, That the courtesies of Missouri State Association of Architects be extended to the members of the National Electric Light Association, now assembled in Kansas City, and that they be invited to inspect the exhibit of architectural drawings in Parlor S, Midland Hotel.

Respectfully,
JAMES OLIVER HOGG, Secretary.

Secretary Garratt read the following response on behalf of The National Electric Light Association :

COATES HOUSE, KANSAS, CITY, MO., February 11, 1890.

James Oliver Hogg, Esq., Secretary Missouri State Asssociation of Architects, Midland Hotel.

Dear Sir : Your courteous favor of even date is at hand, and many thanks are hereby expressed for the courtesy therein contained. I will present your letter to the Association at its forenoon session to-morrow.

Very respectfully,

ALLAN V. GARRATT,

Sec'y and Treas.

On motion, the matter was referred to the Executive Committee, with power to act.

The Secretary read the following telegram :

NEW YORK, February 11th, 1890.

E. R. Weeks, President National Electric Light Association, Kansas City, Mo.:

Sorry to be debarred from attending the Convention. Association has our heartiest good wishes and will always have our best endeavor. May its deliberations be marked by western breadth and southern generosity, and may it grow as fast as Kansas City. Signed, T. C. Martin and Joseph Wetzler, Editors, "Electrical World."

On motion, the telegram was received and ordered spread upon the minutes.

THE CHAIR : The first thing on the programme this morning will be the report of the Committee for the Abolition of Customs Duty on Copper, which will be presented by Mr. George M. Phelps, of New York.

Mr. Phelps presented the report of the Committee, as follows:

REPORT OF COMMITTEE ON COPPER.

BY G. M. PHELPS.

The Committee appointed at the last meeting of the National Electric Light Association to petition the proper Committee of Congress for the abolition of duty on copper, appeared at Washington, January 16th, through Mr. Phelps, who presented the following petition to the Committee on Ways and Means, with the subjoined address :

Petition to the Honorable Committee on Ways and Means, House of Representatives, U. S. A.:

The subscribers were appointed a Committee to petition your honorable body for the abolition of duty on copper ingot, plate, bars, rod and wire. We represent The National Electric Light Association, a body composed of representatives of electric lighting companies throughout the United States, and

also manufacturers of and dealers in electric lighting apparatus and supplies. The resolution appointing this Committee was passed without a dissenting vote. We, therefore, have the honor to present this petition, earnestly requesting that the action asked be taken as a measure, which will be approved by the great body of users and manufacturers of copper.

CHARLES A. BROWN,
GEORGE M. PHELPS,
J. F. MORRISON.

In presenting the petition, the following address was made to the Committee on Ways and Means:

"The National Electric Light Association consists of corporations, firms and individuals, owning and operating stations and plants for the distribution of light and power by electricity. At the time of the last Convention of the Association, August 6th, 1889, the capital then invested in the industries above named was estimated, from statistics collected by the Secretary of the Association, to be not less than $275,000,000. This sum represented mainly electrical apparatus and electric conductors for the supply of 238,000 arc lamps and 2,700,000 incandescent lamps, in all which apparatus and conductors, copper is an indispensable and chief material. In the total cost of electric plant for light and power distribution, it is estimated, by competent experts, that from one-fourth to one-third is expended for copper. The foregoing figures and statements sufficiently indicate the magnitude of the interest of electric light and power companies in the price of copper. In the opinion of the petitioners, the proposed abolition of the copper tariff does not touch the question of protection to American industry. The duty on copper appears to be wholly superfluous as a protection to American producers of that metal. The United States not only produces more copper than it consumes; and consequently exports that metal, but it possesses the richest and most easily worked copper mines in the world, and its mining companies produce the metal and put it in the market at a lower cost than is possible to the Spanish or Chilian miners. Obviously the American producers of copper require no duty to protect their domestic market, and their exports of copper furnish sufficient evidence of their ability to meet competition in foreign markets. The existing duty is of no appreciable value to the national treasury, because copper is not imported in any considerable quantity. As a source of national revenue, the copper tariff is practically useless, and the returns from it could not be increased materially, under the conditions of production throughout the world, by any modification of the rate of duty, if the government needed increased revenue, which it confessedly does not.

"It would appear, therefore, that the duty on copper can only be efficient in enabling the mining companies and dealers in copper to establish and maintain excessive prices through combination for that purpose. It is believed that the United States duty of four cents per pound was a considerable factor in the operations of the syndicate established in France in the Autumn of 1887, and which syndicate, aided by its agreements and contracts with copper mining companies in this country, succeeded in controlling the copper

production and markets of the world for more than a year, doubling, for a considerable period, in London and New York, the price existing just previous to the beginning of its operations. This was effected, moreover, in the face of an abundant supply of the metal. For some months after the breakdown of the French speculation, the American companies maintained the price in this country considerably in excess of that of European markets.

"Touching the relation of the duty on copper to combinations for maintaining excessive prices, the following quotation is subjoined from an editorial in the New York *Tribune*, May 15, 1889:

"'The mine owners have publicly stated that they are able to produce more than all the copper this country consumes, and a large part of it at a cost not exceeding six cents per pound, and that they propose to the French bankers, who hold an enormous unsold stock, to fix the selling price at about 13 cents per pound—more than double the cost. Nothing need be said about the right of the producer to get a profit of more than 100 per cent. on his copper, provided he is not a beneficiary of a national policy intended to protect and encourage American production. But the mine owners are beneficiaries of that policy, and owe to the public a certain consideration and service in return. If they enter into a combination for the benefit of foreign speculators and bankers against the interests of American producers, the duty on copper may not last long. . . There will, in all probability, be a revision of the tariff next Winter. The party in power being anxious to defend all industries that need and merit defense, will, for that very reason, be more strongly pressed to cut off duties where no defense appears to be needed or where it seems to be not deserved. Combinations of speculators to corner the markets of the world are not highly popular, and will not appear to members of Congress to merit particularly favorable consideration. Under such circumstances, the demand for a removal of all duties on copper ore, pig and bars, will be difficult to resist. It is safe to say that, had the Mills bill proposed no change more unpopular or unobjectionable than that, its public support would have been incomparably greater.'

"In short, and to recapitulate, in the opinion of The National Electric Light Association, the duty on copper, being useless for revenue and unnecessary for protection, should not be suffered to remain on the statute book of the United States, since its only remaining function is to serve as an ally to the promoters of combinations for putting up prices, a process to which the government should not lend its assistance."

After reading the address as part of the report, Mr. Phelps continued:

The Committee has circulated an auxiliary petition in support of the petition presented in behalf of the Association. It has been intended to solicit the signatures of all companies, firms or individuals, engaged in electrical industry, and to offer opportunity for signing to all other persons accessible to the Committee who are in sympathy with the proposed measure. On the 8th of February, 440 signatures to such auxiliary petitions were forwarded to

the Committee on Ways and Means of the House of Representatives. Your Committee are still engaged in circulating copies of the auxiliary petition, and hope to collect several hundred more signatures. The Committee would earnestly request any members of the Association or others inclined to sign the petition, who have not received a copy, to address either members of the Committee, viz., Chas. A. Brown, 227 South Clinton street, Chicago; Geo. M. Phelps, 150 Broadway, New York; J. F. Morrison, 15 South street, Baltimore.

I wish to suggest further that members who feel deeply interested in this matter would, I think, contribute to the success of the pétition, by addressing communications to their several representatives in the National Congress. It seems somewhat problematical whether any discussion of the subject of revenue will be permitted to take place on the floors of Congress this session. But, if such a discussion can be brought about there, it is the opinion of your Committee that the success of their petition is exceedingly probable. There is practically nothing to be said in favor of retaining the duties on copper. I have not heard a word in defense of it. The only persons who have been at all disinclined to sign the petition, have been those who have said substantially, "Yes, it is all right; the duty on copper ought to go, but we make something else, and our friends make something else, that is protected by tariff duties, and we do not want this thing stirred up." We feel that the greatest difficulty will be in getting the thing "stirred up." If it can be "stirred up" and brought to the attention of the National Congress on the floor of the House of Representatives, it is my individual opinion and, I think, the belief of the rest of the Committee, that the copper tariff will not last long.

I ought to say I am but one member of the Committee present. Mr. Brown, the chairman, is unable to attend, and Mr. Morrison, we all know, is unfortunately prevented from being here. I have made out this report after conference with Mr. Brown, but have not been able to see Mr. Morrison.

I ought to say further, perhaps, as a matter of record, that there was no appropriation made for the work of this Committee. Your Committee have expended a considerable sum of money, a great deal of printing and postage being required. In due time, when we are through with our work, we may present, for the information of the Association, a record of this matter.

THE PRESIDENT: That would be eminently proper and will be properly received by the Association, I think.

Gentlemen, this subject is a matter of great moment. Aside from its national, I might say international, interest, it is a matter that comes right home to every one engaged in the electrical business; and it illustrates very nicely the community of interests that prevails, and we should all appreciate and understand it. Whatever affects the manufacturer of electrical apparatus, affects the user of that apparatus, and what affects the user of

that apparatus, must necessarily come right down to the user of the product of that apparatus—the general public. I repeat, gentlemen, that this is a very important question. The report is now before you. What is your pleasure?

MR. A. J. DE CAMP: I move the report be received and the Committee continued. (Seconded. Carried.)

THE PRESIDENT: We will now hear the report of the Committee on State and Municipal Legislation, presented by Mr. Perry, for Mr. Allan R. Foote, the Chairman of that Committee.

MR. PERRY: Your Committee respectfully asks to have the reading of their report passed until to-morrow, when they will be ready to report, possibly at the afternoon session. Your Committee spent more than two hours last evening going over the report, getting it in shape, and they desire to meet again immediately after the adjournment of this session; and I take this occasion to notify every member of that Committee to meet at once at Room 203, Coates House, directly after we have adjourned, for the purpose of further considering the report. We will be ready to report either at this afternoon's session, or to-morrow. I desire the same privilege in respect to the other report, of which Mr. Foote is chairman.

THE PRESIDENT: We will next receive the report of the Committee on Harmonizing Insurance and Electrical Interests. It seems Mr. Alexander, of New York, the chairman of that Committee, is not present in the hall, so we will have to receive that report later. We will now hear from the Secretary the report of the Committee on Underground Conduits and Conductors.

SECRETARY GARRATT: The report of this Committee is in the shape of a letter to President Weeks, and is as follows:

REPORT OF THE COMMITTEE ON UNDERGROUND CONDUITS AND CONDUCTORS.

NEW YORK, February 7th, 1890.

E. R. Weeks, Prest.;

DEAR SIR: As Chairman of the Underground Committee, I would report that it has not been possible to obtain a quorum at any of the meetings that have been called, several of the Committee are not members of the Association, and have sent in their resignation as members of the Committee. Others live at such a distance that renders it impossible for them to attend

any meetings, and some of the remainder do not respond to any communication. Under these circumstances (as the subject is a very important one) it is requested that the Convention appoint a Committee with the idea of bringing in some of the "New Blood" of the Association into this active and interesting field. The experience to be gathered from the operation of such wires that have been buried in New York City (most of which have proved failures up to the present time) can be easily gathered in time to report to the next meeting of the Convention. Very truly yours,

EUGENE T. LYNCH, JR.,
For Committee.

MR. DE CAMP: I move the report of the Committee be received and the Committee discharged. (Seconded. Carried.)

DR. MASON: Mr. President, I move, in accordance with the recommendation of the Committee whose report we have just received, that the Chair appoint the Committee which is referred to in the report.

THE PRESIDENT: How many shall compose the Committee?

DR. MASON: I am not prepared at present to make a suggestion in that regard. The appointment of this Committee is very important. The Committee should be, as Mr. Lynch suggests, carefully selected and embrace some of the fresh blood of the Association. I would like to have the Association placed on record as authorizing the appointment of the Committee and leave its membership open for further consideration. (Seconded. Carried.)

THE PRESIDENT: We will now receive from Mr. Smith the report of the Committee on Standardization of Potential on Street Railways.

REPORT OF THE COMMITTEE ON THE STANDARDIZATION OF POTENTIAL FOR STREET RAILWAYS.

Gentlemen of the National Electric Light Association:

In behalf of the committee appointed at your last meeting for the standardizing of potentials for electrical apparatus for street railway systems, I would present to the Association the following report:

It was deemed advisable by the members of the committee to send out a circular to all railway companies operating their systems of car lines by electricity, notifying them of the appointment of this committee, and asking not only their co-operation, but also drawing their attention to a number of ques-

tions that we desired they should reply to. Acting upon this conclusion, the committee drew up and mailed to all these companies the following circular:

Gentlemen: At the semi-annual meeting of The National Electric Light Association, held at Niagara Falls, on August 6, the following resolution was offered and adopted:

Whereas, It is the belief of the members of this Association that the electric motor service upon street railways will require a service of electric current for the motor that will be reliable and constant, and that the various electric light stations are capable of generating and distributing such current;

Resolved, That a committee of three be appointed by the President, who shall endeavor to make such arrangements with the manufacturing companies that they should adopt some standard potential to be used upon the various railways. The committee also to collect such data regarding the supply of current to railways as may be deemed of interest to the Association.

The President appointed Messrs. Eugene T. Lynch, Jr., of New York; T. Carpenter Smith, of Philadelphia; and Marsden J. Perry, of Providence, as members of that committee.

It has been thought advisable to collect and compile the opinions and the experiences of such street railways that have adopted electricity as a motor power. Will you, therefore, kindly fill out and answer such of the following questions as you feel you can answer?

1. What system do you use?
2. What proportion of your cars are equipped with motors?
3. Do you generate your own electrical power, or are you supplied by an electric light station?
4. What proportion does your greatest average horse-power in use bear to the total horse-power of engines and boilers which you have installed?
5. What is the voltage or pressure of your generators?
6. Is there any other railroad in your town using an electric system? If so, what system do they use, and do you know the pressure at which they run?

We have received replies from 85 per cent. of all the electric street railway companies. They have one and all showed every disposition to give us full reports upon the questions that we have asked them, and have stated that they would afford us every facility that lay in their power, and that they desired us to convey to The National Electric Light Association their hearty endorsement of this plan.

We think it advisable to divide our report into three parts. First, a statement of the conditions under which the various railways have been operating up to the present time. Second, the report of your committee upon the arrangements made with the manufacturing companies. Third, a set of statistics carefully compiled from reports made by some of the most prominent central stations, showing the advantages that will accrue to the investor by the combined operation of the electric light and electric street railway interests working under the agreements that have been promised to your committee.

First. Under the first question we do not desire to give any statements regarding the number of railways that may be operated by any particular Company, beyond the fact that fully 90 per cent. of all the railways now in successful operation are operated under the systems controlled by the Thomson-Houston and Sprague Companies.

In answer to our second question, we find that at least three-fourths of the railways have equipped all their cars with motors, and that the sizes of the motors upon the cars vary from 7½ to 15 horse-power.

Only nine electric light companies have been brave enough to agree to supply the street railway companies with their power, although in nearly every case when the railway was in operation, there was at least one central station company who could have contracted to supply the necessary current.

The answers to the fourth question give to your committee the information that will prove of value to the Association.

In all railways operating over 15 cars, only one-third of the total horse-power with which the plant has been equipped has ever been called for at one time. On all roads operating between five and 15 cars, the greatest average load has not reached 50 per cent. of the total horse-power, and upon smaller roads the average load has varied from 50 to 80 per cent. of the total horse-power. All roads that have met with heavy grades have raised the average very considerably.

We find that the potential varies from 220 to 800 volts. The greater number of companies, however, report using a potential between 450 and 550 volts.

Our sixth question was directed partly as a check upon our being furnished correct information upon the names and locality of the various roads, but mainly to ascertain whether an opportunity was afforded to operate several street railway companies from the same station plant.

The answers to this have been many and curious. In some cases they have disowned all knowledge of the existence of any other company, and in nearly every case they seem to be imbued with the rivalry, quarrels or misunderstandings of the various parent or manufacturing companies whose apparatus they are using. They agree, however, that they would be willing to use the power supplied to them from one central station, provided, that they be assured by the company who equipped their road that the potential or quantity of current used would not be detrimental to their apparatus.

Copies of the circulars, together with a letter explaining more fully the plan suggested by your committee, were sent to all the manufacturing companies. They were also requested to furnish the committee with a list of the particular railways operating under their systems. After much correspondence and many personal interviews, your committee would announce that they have written authority from both the Thomson-Houston and Sprague Street Railway Companies to make the statement, on behalf of their particular companies, that they will agree hereafter to use a standard potential of 500 volts upon all electric street railway equipments that do not require any special apparatus for their successful operation.

In recommending electric light companies to add to their regular central station business the business of furnishing power to street railroads, we wish it fully understood that we do not base any hopes of profits to be made upon the old time idea that the same machinery can be used for furnishing light at night and power in the day time. This specious argument has led many companies into large expenditures for motors, etc., and they have discovered later that it costs nearly twice as much money to run the same machinery night and day as to run it at night alone, and that it pays better in the long run to have an entirely different class of apparatus to produce light and power.

The true direction from which returns may be expected in the massing in large stations of the generation of electricity for both light and power, is found in the fact that any electric light station, to be sure of continuous running, requires a reserve of from 15 to 25 per cent. of its average load in boilers, engines and dynamos; the per cent. being larger in small stations, and diminishing as the station increases in size.

This same reserve in capacity is required for the power station; but on street car work, in most of the stations hitherto installed, this percentage runs very much higher, being from 50 to 80 per cent. It will be manifest to every one, on a little reflection, that a station which is generating current for two street cars, is compelled to have power enough to allow of the throwing on at the same instant of both these cars; that is to say, generating capacity of fully twice the average amount of power, or 100 per cent. reserve; as more cars are added, the chance of any particular number being thrown on at one time becomes less and less, until, in a station operating 200 cars, a single spare generator to take the place of any one which might be disabled, would probably be all the reserve needed. This feature is shown very clearly in the running of the ordinary three-wire electric station, where, when the total load is light, a few lights thrown off or on either side will make a big difference in the balance; but as the total load increases, the number of lamps thrown off or on either side at any one instant is so small a percentage of the total load, that the station needs, practically, no balancing. Now, if any one station supplying electricity for all purposes in a town, we have, say, 25 per cent. reserve in boilers and 25 per cent. reserve in steam engines, in excess of the average load, we shall only require to place 25 per cent. reserve, each, on electric light dynamos and power generators to have practically the same result as though we had two complete and separate stations for electric light and for electric power, each with its popular reserve of 25 per cent. extra in engines and boilers and dynamos.

Another important point to be considered, and one well worthy of consideration by electric light stations, is, that in many cases they could furnish this current delivered at the walls of their stations; that is, the car company will take care of its overhead lines and connections, and the electric light companies be paid a rental simply for the electricity delivered to the car companies' lines.

As an instance of what may be done in increasing the output of a station,

without a corresponding increase in expenses, we quote the case of a small station, which, as nearly as can be determined from results, shows the following condition of affairs:

The station increased its business in 1889, over 1888, 23 per cent., and in the same time the total expenses, including the extra line work and distribution expenses, 10 per cent., which 10 per cent. meant 10 per cent. increase in running expenses, and 10 per cent. in fixed expenses. The company contemplates a further increase of 27 per cent. on the same basis; this increase, however, being for power furnished alone, without any line work involved, the most careful calculation shows that this will only increase the present running expenses 10 per cent., without increasing the fixed charges at all.

In 1888, the proportion of fixed charges to running expenses was 25 per cent. and 75 per cent., respectively, of the total expenses. In 1889, this same proportion held good, each having been increased 10 per cent., as above stated, and the total expenses having increased the same amount. The further expected increase being 10 per cent. of 75 per cent., will mean an increase in the total expenses in 1890, over 1888, of 17½ per cent., while in the same time the total output of the station and consequent gross receipts will have increased 50 per cent.

These figures are all taken from the case of a small station, with a total output of some 350 horse-power, and a fresh increase in this station (above this point) will result in an entirely different condition of affairs, so that a readjustment will take place in the proportion of fixed expenses and running expenses. We, therefore, present the report of another station, which is operating 1,200 horse-power, in which the total operating expenses are divided into 80 per cent. running and 20 per cent. fixed. On increasing the station to an output of 1,800 horse-power, the increase to be entirely in the furnishing of power, the increase on total operating expenses would be about 14 per cent., and the ratios of fixed and running expenses would be as 15 per cent. and 85 per cent.

The report of another large central station, operating at least 2,500 horse-power, has been divided somewhat differently. The fixed charges are 14 per cent. of the total expenditures. All labor and pay-rolls amount to 41 per cent. and all material, such as coal, carbons, lamps, wire, oil, etc., amount to 45 per cent.

Taking into account all their past calculations and experiences, they are very confident that they can operate at least double their present output, be it light or power, at one-fifth more for fixed charges, one-third more for all labor and pay-rolls, and, say, three-fourths more to their present material item making a total additional charge of, say, 50 per cent. upon their present expenditures, and giving them in return at least double the gross income. As stated before, it will not be found advisable to calculate upon using the same engine, boiler and dynamo power for the double service for lighting at night and power during the day time, except, of course, in some few isolated cases.

The great saving for the central station company lies in the reducing in

labor and fixed charges, and also that the reserve power for one will suffice for the other. Your committee feel that a great step has been taken in the right direction in securing the endorsement and co-operation of the largest and leading companies, and they would suggest to the Association that some measures be taken to secure from the stationary motor companies the adoption of some standard potentials for their use upon constant potential circuits.

EUGENE T. LYNCH, JR., Chairman,
129 Broadway, New York.

THE PRESIDENT: Gentlemen, you have heard the report of the committee. It is now before the Convention for general discussion. Is there any one present who would like to speak to this question? It is a very important question, a matter that if properly followed up, will open a very large field for the products of central stations. Whatever gives us a market for our current is of vital importance to every central station man. I should be pleased to hear from any one on this topic.

DR. MASON: Will you allow me to suggest that while the members of the Convention may not now be prepared to discuss the question, it is too important to pass over, and, perhaps, it might be well to assign an hour in a future session to be devoted to the matter brought before us in the paper.

THE PRESIDENT: The suggestion of Dr. Mason is very pertinent, and I think it can be met in this way, that we will have a general discussion of this topic at the same time that we have a discussion on Mr. Sprague's paper on Electricity as Applied to Street Railways. Therefore, we will pass that for the time being, and we will hear from Mr. P. H. Alexander, of New York, the report of the Committee on Harmonizing Insurance and Electrical Interests.

Mr. Alexander then read the report of the committee, as follows:

REPORT OF THE COMMITTEE ON HARMONIZING INSURANCE AND ELECTRIC LIGHTING INTERESTS.

BY MR. P. H. ALEXANDER, CHAIRMAN.

The Committee on Harmonizing the Insurance and Electric Lighting Interests was continued at your session held at Niagara Falls, last August, and requested to confer once more with the fire underwriters regarding the best means of preventing fires from electricity, and to try and bring about a reduction of insurance on the buildings lighted by electricity. The committee has had many sessions, and a great deal of correspondence with fire under-

writers, and can only reiterate the recommendation made at the last meeting of this Convention regarding the desirability of examining and licensing men employed in electric lighting, and would further recommend all electric light companies to contribute toward the remuneration of several expert electrical engineers in different parts of the United States, who should instruct special agents or inspectors of insurance companies in the necessary knowledge to discern between good and bad electrical installation. The committee thinks that special agents and inspectors of insurance companies ought to qualify themselves in inspecting electrical installation, as far as fire is concerned, the same as they qualify themselves in inspecting other appliances put up in buildings, and judge of their relation to fire hazards. The committee realizes that as long as inspectors are employed at the expense of the electric light companies, underwriters will take no pains to acquire for themselves the necessary knowledge to inspect such risks. The committee would, therefore, recommend to electric lighting companies the appointment of an instructor to special agents for a period not exceeding one year, feeling certain within that time every special agent and inspector of fire risks could acquire all the necessary knowledge to enable him to judge of electrical installation as far as it applies to fire hazards. The committee has communicated this, its ideas, to underwriters' associations and insurance boards, but must confess that it has not met with the favorable responses to this proposition that it anticipated; however, the insurance interests seem to be willing to take some steps to bring about the harmonious relations so much desired. Your committee was also instructed to report upon the advisability and feasibility of a mutual insurance company for insuring central stations. A plan was proposed by S. E. Barton and Captain William Brophy, both of them well known to you, for the establishment of such a mutual insurance company, a prospectus of which is filed herewith, and has been forwarded to the members of this Association. The committee, after carefully considering the plan of operation as prepared by these gentlemen, has unanimously endorsed their ideas, as have a great many central station men of note, members of this Association, as well as of the Association of Edison Illuminating Companies. The plan proposed will not only reduce the cost of insurance, but will aid in perfecting the construction of central stations; and by frequent inspections will aid the managers of such stations in the knowledge of modern appliances. Your committee would be glad to have this matter freely discussed here to-day to see if the project is not worthy of the official endorsement of The National Electric Light Association.

THE COMMITTEE,
By its Chairman.

Kansas City, Feb. 11th, 1890.

PROSPECTUS OF THE ELECTRIC MUTUAL INSURANCE COMPANY.

It is proposed by the undersigned to organize and incorporate a company under the above name and title for the purpose of insuring electric light and power generating or distributing stations (building and contents) throughout the United States (and possibly Canada) against loss or damage by fire; the company to be located in Boston, Mass.

DEMANDS FOR, AND PROSPECTS OF, SUCH A COMPANY.

The electric lighting and power industry having become so firmly established; having settled itself into so permanent and substantial a condition; such a large number of model and costly plants having been constructed during the past year or two, or being at the present time in process of construction or in contemplation; in fact, an era of substantial progress almost unprecedented in any line of industry, having set in; and it being extremely difficult to obtain insurance on the property owing to the lack of knowledge on the part of fire underwriters as to the fire hazard pertaining to this class of risk, a universal demand for insurance at reasonable cost exists throughout the country.

It is believed by the undersigned that the electric generating station can be made as free from fire hazard as any other class of risk where mechanical power is being utilized, and it can certainly best be made secure through some medium which shall point out safe modes of construction and equipment that do not always suggest themselves to the station managers and owners. Such a medium would be the managers and inspectors of an insurance organization having for its object the supervision of such property and the furnishing of indemnity against fire loss at its exact cost.

THE STANDARDIZING OF RISKS.

In order that a mutual insurance company may serve its members or policy-holders with equal benefits, it should have presented to it for insurance risks as nearly equal as possible in hazard so that they may be assumed at nearly the same rate of premium.

It has been found by a comprehensive examination of the stations now in operation, that they differ to a considerable extent in such particulars as modes of construction, safety of electrical equipment, and means for extinguishing fire. Hence, in their present condition it seems necessary to classify the risks upon a schedule to be adopted by the directors of the company, charging a higher rate of premium for such risks as are found to be below the standard from an underwriter's point of view, the rate to be graded according to the variation of the risk therefrom.

Of course, it will be impossible, owing to widely varying circumstances and conditions, to carry out the ideal of mutual insurance by having all risks exactly alike in point of hazard, and insuring them at one uniform rate; but it is believed that the company can begin business with not more than five classes, and that within one year that number can be fairly reduced to two or three by alterations and improvements made through the standardizing process under which it is proposed to work.

THE CHARACTER OR KIND OF STATIONS TO BE ACCEPTED.

It will be the policy of the company to deal only with the legitimate hazard of electric light and power generation and distribution, and to that end those stations which have unfortunately been located in buildings where other industries are carried on, as well as those seriously exposed by other hazards,

will be avoided. Such a policy will be necessary to the success of the company, as the unknown hazard of promiscuous industries cannot be fairly computed in rate of premium, nor can they be controlled by the system of inspection proposed, which system is the vitalizing source of the prosperity that has attended the manufacturers' mutual insurance companies of New England.

Recognizing the liability of fire from unforeseen causes, however carefully they may be guarded against, prudence dictates the providing of suitable fire extinguishing appliances; therefore, it will be the policy of the company to avoid those stations which are without proper apparatus of their own, or beyond the protection of public appliances, and in which a fire would probably result in a total loss.

BUSINESS TO BE SECURED BY THE COMPANY IN THE BEGINNING, AND AMOUNTS TO BE ACCEPTED ON A SINGLE RISK.

There are in the United States over 1,000 central stations, with a probable average valuation of not less than $25,000, making (at a moderate estimate) an insurable value aggregating $25,000,000. Of these 1,000 stations, it may fairly be assumed that at least one-half would be acceptable as initial risks.

It is proposed to begin with a maximum line of $25,000 on a single risk, and reduce that line according as the risk varies from the standard; so that it may be fair to assume that 500 risks, at an average of, say, $15,000, amounting to $7,500,000, can be pledged and accepted by the company in beginning business.

In New England there are 100 acceptable stations on which it is believed an average of $15,000 will be pledged at once, so that $1,500,000 can reasonably be counted on from that section alone.

Considering the rapid growth of the industry, the present tendency toward improved construction and equipment, with a view to permanency and enlargement, together with improvements that may easily be made in many of those stations that are not acceptable in their present condition, it does not seem unreasonable to predict that within one year the business of the company will be increased 50 per cent. When its success shall have been demonstrated and its financial condition warrants, the amount carried on each risk may be increased and its volume of business thereby greatly enlarged.

RATES OF PREMIUM, PROBABLE INCOME AND EXPENSES, AND DIVIDENDS TO BE RETURNED TO POLICY-HOLDERS.

It is proposed to make the initial rate on a standard station one per cent. per annum, that rate to be increased according to the application of the schedule to be adopted, but not to exceed two per cent., any station rating higher to be declined until so improved as to bring it within this limit. (A lower rate than one per cent. may be adopted for stations constructed wholly of fireproof material.)

With the above rates, and on a basis of $7,500,000 insurance, as previously estimated, it seems within the range of conservative calculation to predict a premium income of $100,000 the first year.

From this income must be paid all expenses, such as salaries of officers, inspectors and clerks; traveling, incidental and office expenses and taxes; also all losses by fire. Calculating from statistics of fire losses already at hand, a good dividend can be expected; but the promoters of the company are sanguine in their belief that through their selection of risks, and the avoidance of losses by gradual improvements that will be carried out, and by the system of inspection that will be maintained, the loss ratio can be so reduced as to enable the company to return to policy-holders at expiration of policies, from 50 per cent. to 75 per cent. of the premiums paid, on the basis of rates previously named.

PERCENTAGE OF VALUE OF PROPERTY TO BE COVERED BY INSURANCE.

With property under protection of good fire departments or other reliable and valuable appliances for the extinguishing of fires, where in all probability the loss would be but partial, the question of the percentage of insurance that shall be carried, as to the value of the property covered, is an all-important one in determining the rate of premium. Particularly is this so with mutual insurance, where all policy-holders are entitled to equal benefits.

The policy-holder carrying insurance of but 50 per cent. of the value of his property, where the chances are, say, 50 to one, that in case of fire the loss could not exceed 50 per cent. of the value, is receiving a decided advantage over policy-holders in the same company, with the same class of property and paying the same rate, but insuring to perhaps the full value of their property. Hence, fairness to all demands that all shall insure up to approximately the same percentage of their value, and custom with both mutual and stock companies has fixed that proportion at about 90 per cent. of the actual insurable cash value.

THE PLACING OF SURPLUS INSURANCE BEYOND THAT CARRIED BY THIS COMPANY.

The results secured by the manufacturers' mutual insurance companies of New England, in protecting the better classes of manufacturing property for a quarter of a century past at considerable less than one-quarter of one per cent. per annum, has convinced stock fire insurance companies of the desirableness of such risks at exceedingly low rates. The undersigned, therefore, have no doubts whatever of their being able to place with the leading stock fire insurance companies, all insurance beyond what this company can safely carry, and at rates very much less than are now being or than would otherwise be charged by the same companies, as they will be entirely relieved of the cost of examining the stations, relying wholly upon the inspection that will be made by this company.

The guarantee of approved construction, safe electrical arrangements, proper equipment with fire apparatus, and maintenance in such a condition of safety as will result from the supervision and inspection of the mutual company, will be sufficient to induce stock companies to freely accept the insurance at much lower rates than otherwise.

This company will undertake to arrange with a sufficient number of stock companies to provide for all surplus insurance, applying a ratable proportion of the commissions which will accrue from that source to the reduction of its expense ratio, thereby enabling it to pay correspondingly larger dividends on expiring policies.

THE BENEFIT OF SYSTEMATIC AND INTELLIGENT INSPECTION.

Fire underwriters, realizing the great number of losses that may be avoided by systematic inspection of risks at frequent periods, have, within recent years, established regular bureaus of inspection in many of the large cities, notably in Boston, New York, Philadelphia and Chicago, and also other bureaus, each covering several States. The success which has attended the inspection feature of the New England manufacturers' mutuals has already been referred to and is too well known to need elaboration.

It is proposed to maintain a similar system of inspection, giving each station as many examinations per year as may be thought advisable by the directors. For this purpose a sufficient number of skilled inspectors will be employed.

In addition to the expectation of a materially reduced cost of insurance, it should be borne in mind by managers and owners of light and power stations that great benefit will accrue to them from the periodical visits of the competent inspector, who will be expected to give each company advice and instruction as to reducing the fire hazard, which will of itself more than compensate for the amount of premiums paid.

Respectfully,

STEPHEN E. BARTON, Boston, Mass.
WILLIAM BROPHY, Boston, Mass.

Endorsed and recommended by

P. H. ALEXANDER, MARSDEN J. PERRY, HENRY B. CRAM, M. J. FRANCISCO,	*Insurance Committee, National Electric Light Association.*
W. J. JENKS, C. L. EDGAR, THOS. P. MERRITT.	*Insurance Committee, Association of Edison Illuminating Companies.*

J. F. MORRISON,	Baltimore, Md.
S. A. DUNCAN,	Pittsburgh, Pa.
EDWIN R. WEEKS,	Kansas City, Mo.
ELIHU THOMSON,	Lynn, Mass.
THOS. A. EDISON,	Orange, N. J.
WM. A. ANTHONY,	Hartford, Conn.
DR. OTTO A. MOSES,	New York.
A. J. DE CAMP,	Philadelphia, Pa.
FRED. A. GILBERT,	Boston, Mass.
F. S. HASTINGS,	New York.

ALLAN V. GARRATT, - - -	New York.
JOHN I. BEGGS, - - - -	New York.
EUGENE T. LYNCH, JR., - - -	New York.
W. H. MCGRATH, - - - -	New York.
T. CARPENTER SMITH, - - -	Philadelphia, Pa.
ROBT. L. MORRIS, - - - -	Nashville, Tenn.
ALLEN R. FOOTE, - - -	Washington, D. C.
JAMES ENGLISH, - - - -	New Haven, Conn.
B. E. SUNNY, - - - -	Chicago, Ill.
H. N. BIGELOW, - - - -	Clinton, Mass.
CHAS. R. PRICE, - - - -	New Bedford, Mass.
R. B. TABER, - - - - -	New Bedford, Mass.
THOS. T. ROBINSON, - - -	Dedham, Mass.
C. D. MORSE, - - - - -	Millbury, Mass.
THEODORE C. BATES, - - -	Worcester, Mass.
STEPHEN SALISBURY, - - - -	Worcester, Mass.
THOMAS M. ROGERS, - - -	Worcester, Mass.
ELISHA MORGAN, - - - -	Springfield, Mass.
COL. E. A. BUFFINTON, - - -	Leominster, Mass.
E. W. BURDETT, - - - -	Boston, Mass.
CALVIN D. PAIGE, - - -	Southbridge, Mass.
HON. LUTHER HILL, - - - -	Spencer, Mass.
HON. C. C. CORBIN, - - -	Webster, Mass.
H. M. DAGGETT, JR., - - -	N. Attleboro, Mass.
DR. ROBERT AMORY, - - -	Brookline, Mass.
H. F. BURGETT, - - - -	Brookline, Mass.
JOHN F. SPRING, - - - -	Greenfield, Mass.
FERDINAND A. WYMAN, - - -	Hyde Park, Mass.
HENRY H. TRUE, - - -	Nantick, Mass.
F. M. LAUGHTON, - - - -	Bangor, Me.
F. A. SAWYER, - - - -	Portland, Me.
F. J. ROLLINS, - - - -	Portland, Me.
A. W. YOUNG, - - - -	Waterbury, Conn.
GEO. B. NEAL, - - - -	Charlestown, Mass.
VINCENT C. STONE, - - -	Fargo, North Dakota.
CHARLES R. FABEN, - - - -	Toledo, Ohio.
P. F. MOREY, - - - -	Portland, Oregon.
GEO. B. EDWARDS, - - - -	Charleston, S. C.
JOHN B. GARDEN, - - -	Wheeling, W. Va.
S. S. BADGER, - - - -	Milwaukee, Wis.
ARTHUR STEUART, - - -	Baltimore, Md.
GEO. H. ROE, - - - -	San Francisco, Cal.
C. H. SMITH, - - - -	Denver, Col.
H. E. W. PALMER, - - - -	Atlanta, Ga.
C. H. WILMERDING, - - -	Chicago, Ill.
JOHN CRAVEN, - - - -	Indianapolis, Ind.

L. A. Beebe,	- - - -	Hutchinson, Kansas.
A. H. Barret,	- - - -	Louisville, Ky.
Wm. R. Wood,	- - - -	Portland, Me.
J. E. Lockwood,	- - - -	Detroit, Mich.
S. S. Leonard,	- - - -	Minneapolis, Minn.
Joseph A. Forbey,	- - - -	St. Joseph, Mo.
Alonzo Elliott,	- - -	Manchester, N. H.
Henry W. Pope,	- - - -	Elizabeth, N. J.
E. W. Maher,	- - - -	Albany, N. Y.

In submitting the foregoing prospectus, we desire to add the following remarks on the subject:

We believe that the art of distributing electric light and power has developed to that magnitude where the business justifies the establishment and maintenance of an insurance organization distinctively its own, which can, by demonstrating that electric generating stations *need not* be hazardous risks, reduce the cost of insurance to the minimum.

As will appear by the prospectus, the proposed line of operation is a conservative one, the important features of which are these:

That the business shall be confined exclusively to the hazard of electric light and power generation;

That the greatest care shall be exercised in the acceptance of risks, to the end that none shall be assumed until the hazards incident to pioneer and faulty constructions have been removed;

That no risk shall be accepted unless provided with a reasonable equipment of fire apparatus, in order that the company may not be imperiled by the liability of total losses;

That risks once accepted shall be maintained in an acceptable condition by a system of periodical, searching and intelligent inspection.

To provide for a financial strength that shall guarantee the company's ability to meet its obligations, even under most disastrous and unexpected circumstances, a premium note will be required of all policy-holders, in addition to the cash premium. The amount of this note will probably be fixed at four times the cash premium.

It will represent the maximum liability of the assured to assessment, and will be surrendered upon the expiration of the policy for which it is given.

It must be borne in mind that the widely scattered location of electric light and power stations (but one or two being usually found in any one town or city) renders the *conflagration hazard*, which constantly threatens and often "wipes out" the ordinary fire insurance company, non-existent in the case of the proposed organization, consequently, nothing, save individual fires in an epidemic form, could force the company to call upon its deposit notes. On the contrary, the promoters of the company will be disappointed in their most sanguine hopes if they are not able to return in the way of dividend, nearly, if not fully, 75 per cent. of the *cash* premium.

The fact of the successful operation of a company confined exclusively to

the insurance of electric generating stations, would doubtless tend to considerably allay the uncalled-for public alarm, at the present time so rampant.

If the formation of the company commends itself to your judgment as being wise and desirable, you are hereby solicited to pledge insurance upon the enclosed blank, and forward the same to the subscribers at your early convenience.

The Statutes of Massachusetts require that certain amounts of insurance shall be pledged before a charter can be granted for the formation of such a company.

If favorable response is made to this solicitation, it is hoped that the company can be organized and begin business early in the present year, and of which action due notice will be given.

Very truly yours,

S. E. Barton,
Wm. Brophy.

Address: P. O. Box 2343, Boston, Mass.
Boston, January 15, 1890.

The Chairman introduced George Cutter, Esq., of Chicago, who addressed the Convention upon the subject of Mr. Alexander's paper, as follows:

Gentlemen of the Electric Light Association: I propose to speak to you simply in an off-hand manner. I feel free to do so, as I have almost the courage to put myself before you as the mouthpiece of the electric light men in the West. We have looked East for information as to harmonizing electric light and insurance interests. We feel, to-day, that this is necessary, and that we will derive a great deal of good, both the insurance interests and the electric light interests, from action of this kind. A thing of great importance to us in the West is to have this movement pushed rapidly forward, so that our electrical engineers will know what is best for the best class of work. We have constantly cropping up before us people who want their work done according to insurance rules. We have no insurance rules. I should say we have a variety, but one engineer works upon one line of insurance rules, and another engineer follows another line. For instance, a short time ago a movement was started in Lake View to compel putting wires underground. As a sort of compromise, it was published in the papers that a compromise was made by which the wires were to go under the street and then over the housetops. In some insurance rules special mention is made that the wires should be kept away from the buildings; and this appears to us as all-important.

I feel that if a committee composed of electric light men and insurance men would work together to outline a national line of rules to influence the electric installations all over the country, we would all be benefited by it. The necessities of the case have given rise to the growth of another line throughout the West, that of consulting engineers. The uncertainty amongst purchasers of electric light plants, from the many contradictory statements made by salesmen, has made a demand for consulting engineers in the West, and this demand is being filled in a very unsatisfactory manner. They are opening offices in different places and traveling about as consulting engineers, and among them are many who have no practical experience whatever in putting in installations. They drift around and talk with one party and another, and in that way get a little information.

I feel that in connection with this committee, in the same line of thought which is advanced in the report, a superintendent of installation should pass an examination. This would sift out these so-called electrical engineers, whose knowledge extends, perhaps, to the putting up of a vibrating bell somewhere, and who know absolutely nothing about electric light plants. The inspection of an electric light plant requires experience in installing the same, and in handling the apparatus, and that would be one point to be taken into consideration by a joint committee working in harmony. Now, the thought that I wanted to express is as to the value of a standing committee, composed of electric and insurance people working in harmony, to keep pace with the growth of our industry, so that we may know the best method of installing the apparatus.

New ideas are being advanced constantly, and there is a diversity of opinion as to the correct use and installation of apparatus. This committee should be ready at all times to act, and should very carefully study the question, so that they may outline the proper rules.

It seems to me the question divides itself practically into two parts; one, the insurance of the central station, in which the situation becomes simply that of buyer and seller; second, insurance outside of the central station. There our interests are identical. The electric light companies want that work well

done, so that they will have no unnecessary expense, and so that the public will feel that they will have no accidents. The insurance people also want the same thing. Their interests are identical, and it is in this line particularly that a committee consisting of members of both branches, working in harmony, would accomplish a great good. Therefore, the consideration of the question could be left to a committee appointed by The National Electric Light Association, and representatives of the insurance companies. In all probability, that committee would consist of members in different sections of the country, so that the tendency of sentiment in each section would be represented in that committee. Such a committee would soon get a thorough knowledge of the various rules for installation throughout the country, amongst the electric light people, the underwriters and the architects, and this, together with the knowledge of the members of the committee, would bring about the adoption of a set of uniform rules which would control our installations all over the country. In this way, the people of the small towns in the country would have the advantage of knowing what the insurance rules were, and would have the means of knowing what proper installation is. The result would be that the public would finally gain that confidence in electric lighting which it deserves, and the purchaser of an electric light apparatus would have information as to what good installation is. Therefore, this committee, which we appoint now, should work in connection with the insurance people, looking to the establishment either of a standing committee or some board which would be a body to whom should be referred important questions for final action in relation to installation.

I think such a body as that would ultimately become a great power in the land, and, with careful work, would make our business known to the people, and do away with the scare which exists to-day, and would also check the growing tendency amongst politicians to interfere with our work. They are finding that it is profitable, and the more they find that out, the more will they interfere with us and our rules unless we have a power, derived from an influence obtained through public opinion, which will check this interference by politicians that would be disastrous to our industry unless it were checked. (Applause.)

Mr. T. Carpenter Smith, of Philadelphia, addressed the Convention as follows:

I am very much in favor of such a committee as has been recommended. I represent a company in what is usually called a pretty slow-going town, but notwithstanding that, we have made progress there. In Philadelphia we have an insurance inspector who has taken a very original course, and absolutely refuses to lay down any rules for wiring, on the ground that just as soon as an absolute rule is made, just so soon will be found the means to evade it. He has also been opposed very much to the licensing of wire men, on the ground that while you may very easily control by a license system the extent of a man's knowledge, you cannot control his trustworthiness. We have men who are doing wiring as contractors in Philadelphia, who can pass any examination which can be made. Yet those men will deliberately splice underwriters' wire on the inside of a building, and splice waterproof wire on the end of it, where it comes out, and they will even wrap tin-foil around the splice, so that it looks as if it was soldered. (Laughter.) Now, no licensing system will control men like that. These are the points which I think the committee should take very carefully into consideration when they try to draw up any set of rules.

After all, it comes down a great deal more to common sense than electrical knowledge in doing wiring, especially about central stations. At one time in the early history of the art, underwriters' wire was cleated to the floor and run through a house without any rubber around it, and it was thought that was good enough. Then we got a great scare about the waterproof business, and everybody lumbered up space with rubber-covered wire and other things. Then we got to running rubber-covered wire on glass insulators, and thought that was just the thing; but a day came when we found that the rubber cover carried the flame better than the electricity did. Now, we have got down to porcelain and glass insulators. We have begun to find that our old, despised friend, the underwriters', is not a bad thing to go through a building, because, while it may get wet, it will not carry the flame. I think 90 per cent. of the cases occurring in Philadelphia come from the flexible cord, which has been handled until all the strands are broken, and all at once a little

blaze is discovered on the ceiling. The people then, instead of knocking it down and throwing a bucket of water on it, run out of the room, and before anything is done to check it, it has got a great deal of headway and makes trouble.

Now, we are going through a little circus in Philadelphia, with regard to the underwriters' inspection, and a scheme has been formulated which has the germs of a very good system in it. The electric light companies cannot compel a customer to have his building wired properly. If they attempt to do anything of that kind, the customer says: "I will get some other company to do this." And after the work has been once done in his building, no matter how dangerous it is, you cannot get him to change it. There are so many advantages in coming under the law of common carriers, that I think it will be found on examination to outweigh the disadvantages, if we can only get some way of compelling customers to put the wiring in their buildings in a safe condition.

There is no question but that the insurance people can command a customer to do anything. The worst class of customer we have to deal with is the very one who is scared the most about having insurance taken off his building, and a mere suggestion or hint from his insurance company that they will not continue his policy, will bring him to terms in a moment. I think, therefore, that we should attempt to throw the onus of all compulsory work on the insurance companies. It does not affect their business a particle. They can put a man's premium up two per cent., and it makes no difference; they can get his insurance just the same, because they are a strong body, and when they have agreed to do a certain thing, they do it, and no man can afford not to have his place insured.

We are talking of an arrangement which, I think, will go through, whereby the electric light companies are to pay an annual sum to the insurance companies for every arc light installed, and for every incandescent light installed. This is to apply to the maintenance of a staff of skilled inspectors, who shall not merely inspect all new work, but shall periodically inspect all work already installed, so that any changes may be examined, and any man who is found sticking 50-candle lamps on a wire that was meant for 10, can be detected, and this will

be stopped by a power that is greater than the power of the electric light men—the threat of withdrawing their insurance. On the other hand, the incandescent men will also compel the owners of all incandescent lighting plants and arc insulating plants to pay them that higher rental.

The matter really comes down to this: That a certain sum has to be paid every year for skilled supervision and inspection of all new work and all work already installed, the costs of this inspection to be divided *pro rata* among every user of incandescent and arc lamps, the only difference being in the case of people who are supplied from central stations, that the central station shall bear that expense. Now, as a central station man, I think that the cost of such a system would be 10 times paid to an electric lighting company every year, in the satisfaction they would have of knowing that somebody else was responsible for the condition of their numerous wires. An electric lighting company has enough to do to get the current out on the line and make money out of it, without having to lay awake nights worrying over the condition of the wire in the different buildings all over town. We must remember that the electric lighting business is a lighting business; and if you make money in it, you do so, not because the lighting is done by electricity—as a great many people seem to think that because a thing is electric there is millions in it—but you make money in it if at all, because electric lighting is a very good business. Every business must be run in a business-like way, that is the experience of the past, and is what we must do in the future; run every business in a business-like way or the business would never pay. Now, the gas companies have got to a certain condition after 40 or 50 years of hard experience. They did not get their experience from having somebody sit down and figure it out for them. They started, just as we have, by piping people's buildings and doing everything of that kind. Gradually they began to cut off these little luxuries, and now they have got down to delivering gas at the customers' premises. They put their meter in and are responsible for it, and beyond that they are not responsible, and the electric lighting company must get there, too, just as quickly as possible.

M. J. FRANCISCO (Rutland, Vt.): Mr. President and gentlemen:

In regard to this matter that Mr. Smith has referred to, he has overlooked the fact that in New England we have an Association of the very kind that he desires in Philadelphia. It is considered under the name of the New England Exchange, that is, the electric light exchange; and also as the New England Insurance Exchange. The two are working together as one body, practically, that is, the orders of one go into the other and they are enforced by one organization.

Now, then, in regard to this wiring business. If they have the proper men in Philadelphia to examine the wiring, I do not think they will put much tin-foil in place of solder. At least, if they ever try that with Captain Brophy as inspector, they will get terribly left. He is the inspector for New England. If you can find a man who will use tin-foil and have it pass Captain Brophy, I say let it go; the line will be all right. But there we have this plan. They license these men. One of the conditions that has to be considered is the moral character of the man. That man must have a record, he must have a standing, or else he cannot procure a license to do this business. And another thing which is a very important item in regard to this wiring houses and wiring buildings, all such buildings have got to be wired in accordance with the rules of the insurance exchange. After they are wired the electric lighting company invite the exchange to send their inspector there to make an inspection of these wires. If they are in accordance with the rules of the exchange, as well as of the company, they are passed; if they are not, they must come out, they cannot use them, they have got to take them out and put them in as they should be. The moment they refuse to do that, not only have they got the electric lighting company's order to discontinue the current, but they have the insurance exchange to deal with, and they cancel every policy on that property. There are two bodies back of these rules to enforce them. This is the basis on which all this business should be carried out through the whole United States. The organizations of exchanges and insurance companies should be effected throughout the entire United States. That was the plan discussed at Niagara Falls, and that is one of the objects of this committee in making this arrangement.

Now, one word in regard to this insurance business. I have

been engaged in the insurance business for about 25 years, and I have had a good deal of difficulty in getting the companies to believe that electric lighting plants were nice risks, that they were good risks, etc. In the discussion of this exchange business, this matter of these mutual companies has been brought up. We will, of course, run on a stock basis. I have always been a little skeptical, as I have got left once or twice on this mutual business. But in this present Association, the one that has been inaugurated here at this Association and practically endorsed, we have an arrangement with the Association, one practically at the head of it, with two men who have had as long and as varied experience, probably, as any man in the United States. When you put those men with their experience and knowledge at the head of an Association of this kind, to effect and carry out these plans, I consider that we have got a plan that we can all heartily endorse, and one which will give us insurance at its actual cost, and give us insurance in a shape whereby we can cover the property, and not have—as a large number of stations are now—our property without any protection whatever. In the last year I have received 150 if not 200 letters in reference to this insurance matter, asking, "Why cannot we get our property insured, and how can we arrange these stations so we can insure them? Can it be so arranged?" Well, of course, it can be so arranged, but under present arrangements there is no inspection. The new companies being organized do not know what to do; they are going to put in a station, and, of course, they do not understand the rules of the insurance companies, and they do not understand how to arrange these stations, and they may proceed in such way as to destroy their insurance at once. Now, with a proper inspector, he goes there and sees these plans and points out the defects to them and says to them, "Now, here, you fix that matter there in proper shape and you are all right; you can get your insurance without difficulty; it will come all right." And that is just the plan, as I understand it, of this mutual combination that is being organized. They propose to have an inspector who will go to your station, examine it, and if he finds anything that is improper or out of the way, he will explain it to you what wants to be fixed and you go to work and fix it so that it is all

right, and you can procure your insurance at once, and you can procure it at a rate which you can live by. I have letters, numbers of them, from parties who said : "The insurance companies are charging us five per cent on our station." Well, of course, there is some reason for that, as companies do not do such a thing unless there is some reason; but in many instances, it is because the companies do not understand the rules and principles to apply in arranging the stations to properly protect insurance companies. In many instances that is the trouble, and, of course, the insurance companies in a large number of cases have inspectors of insurance risks who know little or nothing about the electrical part of it. They are thoroughly ignorant, in a large number of cases—the insurance companies' inspectors—of the electrical part of the business and the danger of an electrical current. Now, in this case, as I understand it, this inspector is to be a man who thoroughly understands the electrical part and can explain all of those dangers that every station has to meet in running their current and in arranging their station. And I am heartily in accord with the idea, and I trust, every station man will investigate the matter and look the thing up, and take hold of this subject in the proper spirit and carry out, finally, not only the insurance part of it, but also this matter of organizing societies or exchanges for the purpose of combining the interests of the electric lighting people, and the insurance people in regard to wiring, and to, in a proper manner, enforce the rights of the Association in regard to putting lines of wire into different places, as has been mentioned here. (Applause.)

DR. MASON (of Boston): Before Mr. Francisco retires, will you permit me, through you, Mr. President, to ask him a question: Do we understand you, Mr. Francisco, to object to the idea suggested, that there should be a National Insurance Exchange, as there is a New England Insurance Exchange, and as there are other exchanges ?

MR. FRANCISCO : The idea of that is simply this : A National Exchange would be too extended to be practicable. The idea is as suggested by the committee, for instance, we have now the New England Exchange. Then we will take in the Middle States, then the Western States, the Southern States, so as to make a department each by themselves, the same as the insur-

ance companies do at the present time. In the insurance business we have what we call the Northwestern Association, the Southwestern Association, the Southern Association, the Middle Association and the New England Association. Now, under this arrangement of this matter, we can carry it forward on precise the same plan. Divide them up, but have them all under one head in the National Association. Bring them all into this Association, but preserve your different departments, because if you don't it will be too large to manage economically. It cannot be controlled practically, as the territory is too large, unless we do this. You have got to have it so you can divide it, and so that men engaged can go from one point to another without spending a week or 10 days in flying across the country from the Atlantic to the Pacific. It is an important idea to preserve the different associations, but all to come into the national organization and this be the general head.

Mr. De Camp: The same as the National Board of Underwriters.

Mr. Francisco: Just the same; this National Association takes the place of the National Board of Underwriters.

Mr. J. E. Lockwood (of Detroit, Mich.): I would like to suggest in support of the idea that has already been advanced of the harmonizing of the electric light and the insurance interests, a step that has also been taken in the direction of forming State electric light associations. This, it seems to me, is the proper time for the Electric Light Association to make use of the State Association for the purpose of getting direct communication with each local organization in the country. The importance of this question depends, I think, in each State, upon the question of the organization of the electric lighting interest in each State and city. As there are electric light interests in each city, so also are there companies in each city, and the National Association is represented in the local organization. I think if this committee is formed its function could be more properly performed by creating and formulating the ideas derived from men of experience all over the United States, and which information could be gathered and furnished by the State Association. Then let each State Association apply in its own State this information and instruct all of the electric lighting companies and the

insurance men throughout the State with the proper rule for wiring; and then, through its own members, residents of every city of the State where there are electric light plants, see that these rules are carried out. In the City of Detroit, Michigan, we have had the same thing to look out for. We have just formed a State Association for Michigan. We have there a case where there are probably at present not less than a half dozen different companies doing wiring of buildings, in one of which that I know of the wires are being concealed within the mortar; and for a single light they are putting in No. 20 wire, and which I know is smaller than is thought proper. In a building within one square there they are fitting up for two lights, No. 10 and No. 8 wire. Now, I believe, although that No. 8 and No. 10 wire for two lights is all right, but on the safe side, that a man that will make that mistake may, on the other hand, make the mistake which will create a very great danger. We have fortunately not had a great many fires; but we have had our attention called to these facts and to the number of accidents in other cities which have been published in the papers. Our State Association intends making its best effort to thoroughly investigate into this matter of wiring and to formulate rules and endeavor to practically carry out these rules. We shall look over the work of the State and see that no work is done in the future that will not be strictly good electrical work. I only suggest that, and trust that when this committee is formed that it will carry out this work in such a manner as to make the State Associations the mediums of communication between The National Electric Light Association and the people whom we are going to reach.

MR. T. C. SMITH: I merely wish to say a few words in reference to what Mr. Francisco has stated. I do not want him to suppose for one instant that we allow such a state of things to go along when we know them. The point I wanted to make was that the moral character of the wire man was only good when you knew it. We have had a great many bank presidents and cashiers who were very worthy, responsible and trusty men—until they went to Canada. And it is the same way with the wire man. He is all right until you catch him. And in order to catch a man's moral character you have got to have some way to

defend yourself from that man after you have found him out. Now, as I say, our record in Philadelphia on the question of fires, shows we have a good system of inspection there; that is, that the work has been well done. What I mean to say is, that where a wire man is at work on the sixth or seventh floor of a building and he has got one more joint to solder, it is an awful temptation to that man to twist a little copper wire and let that slide in a place where it will never be opened. It is a good deal more of a stress on him, than comes upon a bank president to get out with $100,000, when he is $25,000 on the wrong side of his ledger. It is just that kind of thing that we have to deal with. You take a building with 3,000 lights in it, and there are a good many of such, where every foot of wire is concealed. There you would have to put half a dozen inspectors on that one building, the whole time the work was being done, to know that every joint was soldered.

I am strongly in favor of a committee of this kind; but the point I want to make is, that we must look more to getting honest work, than to laying down rules that can be evaded. You must make it a question of principle. I would like to see some rule or system devised which would be practicable, and leave the question of rules as much in the background as possible.

With regard to electric lighting stations, there is no necessity for concealing work of any kind. The rules that govern ordinary fire risks, I think, apply more to central stations than to any other building. I think there is infinitely more danger in the electric lighting stations from the boilers, engines and heating apparatus, than from the electric lighting wires, except, of course, the habit of throwing water on machinery that gets heated up, and I guess none of us would think of that, although we have heard of such things being done. (Applause.)

Mr. Cutter (of Chicago): Mr. Chairman, about four years ago, I think, the New England Exchange was started. I like the idea of it. But have we got to wait four or five years for an exchange in the West, and then another lapse of time for one still further West, and then, finally, join them in the National Exchange? Can we not start the ball rolling to-day, and from The National Electric Light Association have a National Exchange

that will establish the necessary organization? We do not want to wait longer in the West for the good results that you are getting in the East. We do not want to wait and go from one town to another for the good information that is to be had. We want, if possible, to start some sort of bureau, or exchange, or association, whatever you may call it, that will be a national affair; which will be the center of information for the best class of work and the best policy to be pursued in putting in our plants. And we want, if possible, to start from this Association and at this meeting. The sooner it is done, the better; and immediate action is really essential. We want to start some movement that will establish an international affair.

Now, the New England Exchange has a sound policy, and it certainly seems to me that the ideas expressed by Mr. Francisco are excellent. We want this to be on a national and broad basis. I feel that if the wire men of experience, and the men who are working on important parts of construction, are required to have a certificate from certain associations, and that when any wire man carrying such a certificate is placed on work, and is caught leaving an unsoldered joint, or covering a joint with tin-foil, that he must lose his certificate, that is something more than a moral power; it is bread and butter for the next week or six months, and he will not want to lose that certificate. We want this committee to be appointed on a basis, if possible, for prompt action, to organize The National Electric Light Exchange, if you want to call it so.

Mr. De Camp: Mr. President, this is a subject which, as a central station man, I am interested in; but it is one in which, in its various stages, I have never cared to take any part. I have watched very closely the action of this committee. It is a question that is always before us, and always a source of interest, but it has occurred to me that the committee is doing a great deal of unnecessary work; that is, it is work that will come before them in the future. As Mr. Cutter just remarked very pertinently, we do not want to wait four or five years to educate up a corps of competent construction men. There is one point in this that ought to be considered: the old axiom, no rule is without its exception, is particularly true in this case. What is necessary to be done in one class of work, is not so necessary to be done

in another. Therefore, I think that the true way for getting at this, in the first place, is for this very admirable committee to devote their attention to the education of a corps of first-class inspectors, and let them be taken from among the construction men. Now that works in this way: As long as you are engaged in any business which has the cupidity of the general public to deal with, you are going to be utterly unable to control it by any set of rules and regulations which you may lay down.

In the case of the arc light company, in Philadelphia, at least, and I think it is so generally, the cupidity of the user of the light is not appealed to from the fact that the company itself does the wiring, but in the case of the incandescent company they cannot afford to do the wiring, and happily the rule has not been established. There the consumer pays for his own construction. What is the first thing he does? The lighting company that he applies to for light informs him that it is necessary for him to do a certain amount of work, and that he will have to pay for it. For my part, I would prefer that that should be done by outside parties. I do not consider it strictly in the line of the business in which we are engaged. He immediately sets out to find who to get to do that work. He will give it to the lowest bidder, 99 times in 100. Now, he may have a responsible man bidding on the job, but the man who makes the most plausible statement and makes the lowest bid, will always get it. The party who is letting the work has no means of knowing whether it is a proper piece of work or not. He is not educated up to that, and you cannot educate him, but he will believe what he is informed by the insurance fraternity. He has an interest in his insurance, and he is not going to jeopardize that if it comes down to a fine point, and the question is, whether he will dispense with insurance or dispense with our light; he will dispense with the light every time. But if it is generally known that the insurance company with whom he is doing business have a competent inspector, it is a short road for him then, that man has got to do that work under an educated and thoroughly competent inspector, and it does not make any difference in that case, whether he employs a good workman or a bad workman, until the inspector passes upon it.

Another duty, that I think is an important one, is to educate

the insurance companies themselves to know just how much there is in this business. I think it is Mr. Woodbury who is responsible for the assertion that where establishments were properly wired, the insurance companies expressed a preference for that kind of risk, that they consider it decreased their risk rather than increases it. Now, that is just exactly what we want. That is exactly what will suit every lighting company, and if the insurance companies sustain their present rates on a decreased risk, it will put money in their pockets. There should be no difference between the lighting companies and the insurance companies on that point, but there is a gross inconsistency about this matter between the lighting companies and the insurance companies. We have in Philadelphia, I think, three station risks that are first-class as risks, barring out anything electrical, but still the insurance companies discriminate against those risks, and give us a higher rate. We ask why? Well, it is an electric light plant, that is the only answer we can get. We have to submit to that, because otherwise we cannot get insurance. We get our insurance down one-half, and then it gradually begins to crawl back again. There can be no better proof than that that the insurance companies want our risks, although every once in a while they go up in their rates, and I think that just as soon as we have a corps of inspectors that the lighting companies and the public have confidence in, you will get rid of a great deal of difficulty. It is one of the best ways of rooting out incompetent workmen.

I suppose there are 50, may be 100, so-called construction companies in the City of Philadelphia, to-day, and when we have occasion to discharge a workman, the chances are two to one that he will turn up in time as an electrical engineer; that is the class of men we have going around. Without a dollar of capital they will take a bid on a contract amounting to thousands of dollars; without the ability to carry it out, they manage in some way to get their goods; they will say they have such a contract, and want $400 or $500 worth of goods and cannot pay for them until they finish the job, and when they get paid for it they will turn the money over. That is the only way they can do business. Now, if these men are watched and cannot get their work passed and they cannot pay their bills, their creditors will find

that out as soon as anybody, and, in consequence, there will be no bills to pay, and they will gradually drop out of the field, and that plan will result in raising up a good corps of competent men. We have in Philadelphia one inspector who has done all the good work that has been done there up to this time. He works by no set rules. He goes by common sense, and that he is pretty near right I do not think requires any better proof than the fact of the little trouble we have had up to this time.

Mr Perry (of Providence, R. I.): One very strong point has been brought out by Mr. Smith, and that is that the combined insurance interest, rich in its aggregate capital of hundreds of millions of dollars, this morning requires to have the hat passed around in this Convention to the tune of two cents to each lamp; that is a fact I am very glad to learn, and I shall take that back to my people with a great deal of satisfaction. You appointed a committee a year ago, of which I had the honor to be a member. Its report has been before you for discussion. We labored during the year and brought forth our report, and I am quite proud of it. If we go on formulating exchanges and working down through school districts and up through counties and States and, finally, having this grand National Insurance Exchange, we shall have a grand institution, but what will become of the wiring and the general progress of the business while we are waiting for that concern? If, one year ago, when this committee was appointed by you, gentlemen of the Convention, you had simply recommended to the insurance companies that they send their inspectors to first-class reputable electrical engineers, and they had spent one week in connection with those gentlemen, inspecting the installations in almost any town, at the end of that time or a fortnight they would have had sufficient knowledge to enable them to decently inspect almost any ordinary installation, and the whole thing would have been settled. That is where it has got to come, finally, and we might just as well begin at that point as to spend a year getting there. There does not exist any necessity whatever for this grand and intricate organization—not the slightest. Why should our business be made a special exemption from the ordinary routine by which such matters are accomplished? Why is it that we are compelled to pay 80 cents for an arc light, while a gas company

is called on to pay only 10 cents for a gas burner? There is not the slightest occasion for it, the thing cannot be gotten at. There is no mystery about the carrying capacity of a wire. For one cent you can buy a set of tables which any mechanical engineer will endorse as being perfectly safe to follow. It is a very simple matter, and it is a matter that rests entirely with the insurance company, finally, to say that they will or will not accept the installation. The question of poor workmanship will be settled by that, and that very definitely. When a man or a construction company has made a bid so low that it is necessary for him to put in inferior work to protect himself from absolute loss, and he does it, and the work has been rejected by the insurance inspector, and the man with whom he has contracted has thereby been given a just reason for refusing to pay the bill, and he is obliged to reconstruct it and make it meet the demands of safety, there will be no more trouble, he will not repeat the dôse. He will not want his medicine but once, and all of them have got to take it about once; that is my experience with construction companies. I do not believe that there is the slightest necessity for going into this work at all. I think that this Convention should carry out to a great extent what we have recommended in the reports, that the insurance inspector who steps into a building and is competent to inspect everything in it except electric wires, should make himself competent to inspect that risk and accept or reject it for cause. (Applause.)

MR. ARMSTRONG (of Camden, N. J.): I am very much pleased to hear from this member of the committee, and I trust he will pardon me if I say I like his remarks much better than I like his report. I do not believe that this Convention ought to employ an instructor of insurance inspectors. If we are to go into the business of employing schoolmasters for the populace, the first thing we will have to do is to employ a schoolmaster to go to Ohio. I read in a paper here in town that a member of the Legislature of that State had introduced a bill requiring all the dangerous electric wires to be buried throughout the whole State, and yet confessed in introducing the bill that he had never seen an electric light wire or an electric light until four weeks ago, when he came to Columbus to be sworn in as a member of the Legislature. (Laughter and applause.) I am sorry

to have to admit it, for the sake of the argument, and I trust it may not be held against me, but I have been a member of the State Legislature and I know something of the wisdom and intelligence of State Legislatures, and if it is proposed by the aggregation of the electric light companies of the United States to endeavor to instruct men in what they ought to know, and what they give out that they are competent to do, we might as well surrender to them at once our whole plant and go out of the business. The insurance companies are to insure us, and, as Mr. Smith well said, I think they will very readily and speedily find means to ascertain whether or not the work is done. I happened to be the president of a hotel company that has constructed a hotel within about 30 miles of Philadelphia. We gave the contract to the lowest bidder, and so we ought to do. We would have been unfaithful to our stockholders if, when a man came, a reputable business man, and offered to do certain work for the least price, we did not give it to him. The insurance companies sent their inspector to see the work, and the work was condemned ; we had not paid for it. We immediately notified him that we would not accept his work, and gave the contract to some one else ; the insurance companies did that ; we did not pay for it ; we do not purpose paying for it. We do not purpose paying for this inspection ; they are the ones to do the inspection and tell us whether the work is done satisfactory or not. We do not know anything about it, and we do not want to know anything about it. I am president of an electric light company. I do not propose to have my company either inspect or pay for the inspection of buildings ; we will furnish them the light ; we will furnish them the current ; they are to ascertain for themselves or for the people who underwrite them whether or not the work has been done properly. Now, certainly, I cannot agree with that part of the report which recommends the employment of instructors for a year, for a month, for a week or for a day, for the general or the special agents of insurance companies. Let the insurance companies look to that. Why, we would have to be instructing the mayors of some of our large cities and our city councilmen and our board of electrical control, and everybody else under heaven ; we would have to instruct the populace that they must not go and take hold of a

charged, wire carrying 2,000 volts, or any other number, and not expect to go into the great here-to-come, as one celebrated minister once remarked.

Now, as to the recommendation of mutual insurance companies for electric lighting, I should be very sorry; there has been no reference made to that part of the report, and I should be very sorry to see this Convention, representing what it does, advocate the establishment of any company to manufacture wires, or any company to manufacture dynamos, or any company to manufacture lamps or switches, or anything of that sort, because, as an electric light company officer, I want to get the best at the cheapest possible cost to my company, and I do not propose to start something myself, or in connection with other electric light men, to beat down those prices; I do not propose to go into that business. I have one branch of business, and while mutual insurance companies are a great benefit at sometimes and in some places, and I want to endorse them to that extent most heartily, yet I feel that this Convention would be making almost a fatal mistake if it adopted this report as it stands, recommending the institution of this mutual insurance company. Let us see ourselves that our work, so far as our plant is concerned, is done with regard to our own safety. Let us see that it is properly done, and then we may rest assured, as one gentleman on the Committee, Mr. Perry, I think, said, that this great aggregation of millions of capital in the insurance companies, will furnish to us insurance and underwrite us much cheaper than we can do it ourselves; so do not let us adopt that part of the report. Is there anything else left for us in that report to adopt? I want to adopt every one of the remarks of the gentleman, I am heartily in favor of everything he said, but I cannot be in favor of his report. One gentleman said that they had in their bureau of electrical control, or whatever it was, the New England Electrical Association, I did not catch the name, so bright inspectors that they will never pass tin-foil joints for solder. I did not suppose the pirates in the electrical wiring business would ever attempt to impose upon the people who know how to construct bass-wood hams and wooden nutmegs (laughter and applause), but down our way, near Philadelphia, where we have been honest for more than 200 years, so that we

have grown used to it (laughter), except for a few importations, I suppose they must have been importations—some of those New England inspectors, who discover all these things—we have not had any accident by reason of defective wiring, I believe, in the State of New Jersey, of any moment, that I can recollect, and, I think, none in Philadelphia, and it seems to me that the plan adopted there, whether the companies pay to induce the insurance companies to do it or not, is the best profitable one. I am not in favor, nor will our company pay anything to the insurance inspector. The insurance inspectors do well. We will have notning at all to do with the wiring; we do not want to have any responsibility for it, and will not, and for one, I am not willing to endorse the organization of any electrical mutual insurance company. I vote for the remarks of the gentleman, but not for the report. (Applause.)

MR. PERRY (of Providence): It is quite obvious that I failed to make myself entirely understood. My remarks relating to insurance companies applies specifically to wiring done outside of our stations, but I do unreservedly want to put myself on record as endorsing the plan for a mutual insurance company for central stations.

MR. ARMSTRONG: I do not endorse that part of your remarks.

MR. PERRY: I have not asked the gentleman to do so. I was bound to give him the benefit of his own opinion, and let him give that to the audience, but I want to be distinctly understood as separating those two. I have my own views, as has the gentleman, about the advisability of central stations underwriting themselves. I am clearly of the view, after examining carefully into the workings of our New England manufacturers' insurance companies, that they can get insurance at a less rate than can be given to them by the stock companies, or that they can procure from the stock companies, and, therefore, I want it distinctly understood that I endorse that part of the report.

MR. ALEXANDER: New Jersey, as you all know, is different from any other State in the country, and, therefore, the insurance men there may be entirely different from the insurance men in other States; but we in New England have had the experience that insurance men refuse to insure us. Now, what are you going to do about it? Are you going to go without insurance

because you think they are wronging you? No, you would not do that. They do not know anything about electric light. I do not blame them. They think it is a dangerous element. They say, "We are writing an understood risk, and we ought not to be put to the expense of providing a competent authority to ascertain how to estimate this new risk." They talk very fairly about it, much more fairly than you believe. When they found the risk was a good one, they reduced the rate, and, to-day, every building in Trenton that is lighted by electricity has a reduction of ten cents on its insurance rates. I believe the money paid out by the lighting companies is flowing back into their pockets. Their business has increased rapidly on account of the good inspection, and the good we are trying to do now is to do away with that inspection, and it cannot be done away with anywhere because you will stumble over the same stone that we did. The companies will say, "We won't insure the building, we don't know anything about it." Now, we want their insurance inspectors informed on this subject, and that can be done within six months or a year, and, therefore, the committee thought it would be better for the electric light companies to expend a small amount of money all over the country within the next year to provide the knowledge necessary for proper electric light inspection, and then reap the benefit that we are reaping now in New England.

S. E. BARTON (of Boston): Mr. President, I am very glad that this Association has at last dropped the question of underground or overhead, or quibbling where we should hold our next Convention, and come down to the business of considering the subject before this committee, of which I have the honor of being a member, the question of harmonizing the insurance and electrical interests. I was very much interested in the remarks of the gentleman from New Jersey, but he evidently does not know what is going on in the United States. (Laughter.) I have been an insurance inspector myself for 15 years; I would not consider myself competent to be an inspector to-day; I would not consider myself an insurance inspector in all that that term implies, if I did not consider myself competent to inspect an electrical installation as well as a gas installation, and that is the very point that we are hammering at in the report of this committee. Now, we have had the industry of electrical light-

ing going on in this country 10 years or more, of incandescent arc lighting, and to-day, out of the nearly 1,000 that were employed by insurance companies all over this country, I do not believe you will find two of them that pretend to know anything about the inspection of electrical apparatti. Why is it? Simply because they have let that alone as a subject too deep for them, and left it to work out its own salvation, and in working out its own salvation you have made the mistake here. The installations all over the country abound with errors that are incident to first construction, things that could not be avoided, but things that can be avoided and remedied in the future. Good inspection, you say, is what you want; you don't want to pay for it; you cannot get anything in this beloved country without you pay for it or give an equivalent in some way. Now, we have examined this matter, and we have taken the position that the man to inspect the insurance business is the insurance inspector who inspects every other hazard. He is not competent to do it to-day. You, yourselves, who have been in the business all these years, know that he cannot be competent to do it without more instructions. He cannot qualify himself in a day; he cannot qualify himself in a year, without an instructor. He is busy, day in and day out, from one end of the year to the other, in his regular line of business. Now, we have taken the stand, and hold it, to the proposition that it is wise for the electric lighting people, not this Association, but the electric lighting people throughout the country who put their hands in their pockets and say to the insurance fraternity: "We will provide the instructors, not to instruct the people of the country and the legislators —that would be a hopeless task (laughter)—but to instruct the insurance inspectors in what is necessary to qualify them in their inspection." By the appointment of a sufficient number of instructors you could furnish object lessons to these insurance inspectors, show them what is necessary when they have to discriminate between good and bad work by showing the good and the bad to them, and have the understanding that we do this perhaps as a piece of missionary—call it what you please. This committee was appointed, not to point out what ought to be done, or what are the rights of the electrical people and what are the duties of the insurance people, but its very name says

what it is for; it is to harmonize the interests of the insurance and the electric lighting people, and that is the way we believe they can be harmonized, by conceding on the part of the electric lighting people in the first place so many dollars and cents, to be paid out by you people, and that to end at a given time. Give them fair notice in the beginning that they are expected at the end of that time to have their men qualified and competent to do it, and take my word for it, they will be so, and then you have got your inspectors, you have not got to create them, they are already created, and they have been given the necessary instructious to do just exactly what wants to be done and what you are after. Now, in Philadelphia, as Mr. Smith says, they are doing a grand work, but they are doing simply what we have been doing in New England for years, and you people are reaping the benefits of it. You are getting lower rates of insurance on properties lighted exclusively by electric lights than by any other class, and the insurance side is losing nothing by it, we are making money. From my standpoint as an insurance man, I wish every other kind of illumination was driven out and that electric lighting was the only thing on, we would have a great many less fires. Those, Mr. President, are my ideas with reference to the question of inspection and to the recommendation made by the committee. I believe it is something that ought to be done and the voice of this Convention ought to be unanimously for it, and I believe I can safely speak for the insurance companies and say that they will heartily co-operate with anything in that direction. Now, then, I want to say a few words in relation to the project of an electrical mutual insurance company. I have had it in my mind for some time, if you will call to your minds one year ago at Chicago, in speaking upon electrical lighting stations as fire hazards, I said then that I believed the establishment ultimately of an electrical mutual insurance company, or something of that sort, would be the only solution to the question of insurance on central stations. I believe it more fully to-day, and I also said at that time that I believed that those few companies who are doing business in insuring electric lighting stations to-day, even in their deplorable condition, are making money. Now, I know they are. Since this prospectus

has gone out, no less than eight of the large and prominent English and American stock companies have asked to have a hand in it, just what we want, something that shall prepare the stations to make the risks good, and conduct them so that they will give us a part of the insurance, and that is the plan that is contemplated by the mutual company; it is not intended to antagonize the stock interest at all, but, on the contrary, to take in with it all those who want to come, and eight of them have manifested that desire, and the largest American company, not to call any name, stated to me recently that it has been insuring electric light plants—central stations—for several years at nothing less than two per cent. They have made that the minimum rate and they have taken almost anything at two per cent., and have made money out of it; they have kept it to themselves; they now come forward and say we do not want to lose that class of business, but we want to come into this plan and take our share of it. One of the smallest companies in the country, a company which started a few years ago, told me that it took electric lighting stations simply because they wanted business and could not get anything else, and within two weeks thay have told me that their premiums in two years have been over $60,000, and their losses less than $300 on electric lighting central stations. (Applause.) They want a hand in it; they have found that it was a good business, not because their wisdom taught them in the beginning, but because their necessities taught them. I think that you, Mr. President, advanced the idea to me that you thought your idea of harmonizing these interests did not coincide with the formation of an electric insurance company, feeling that that would, perhaps, antagonize the stock interests. That is not so, in the first place, and in the second place, even if it were so, I would take the mutual insurance company, because it is undignified in the Electric Lighting Association to throw to the stock companies their insurance business as a sop to keep them satisfied. It is not necessary, in the first place.

I want to say a few words in relation to the examination and licensing of men employed in electric lighting installations, the work being done by the New England Electric Exchange. I cannot agree with my friend, Mr. Smith, that that method does

not give a guarantee of the character of the man. On the other hand, that is one of the important features of it. It examines him technically first; it then considers his moral aspect, and not a license is issued until it has been laid before and countersigned by the man who knows him personally and knows his habits and everything pertaining to him better than anybody else, and that is the inspector of the New England Insurance Exchange. Every license has to go before him and receive his countersign, and thereby the exchange has the guarantee that that man is all right in every respect, and I know it is so, because I know that more than one man has not received a license simply because he did not meet the requirements in that one particular phase, while he did meet them in other points. Now, Mr. Smith says we do not need rules for the installation of electric lighting apparatus. I can hardly agree with him there. I, myself, feel that the rules that we have in New England are on the wrong tack, that if those rules were turned around, and instead of saying what should be done in the line of safety, they said what should not be done, it would be more in accordance with my ideas. But we could not start that way. We did not know in the beginning what should not be done. We knew in a crude way what should be done, we have gone on and from time to time, as experience has brought out things, we have added to those rules until they are complicated, and cover a great deal, not of ground, but of paper, and, I believe, as Mr. Cutter said in the beginning, that it would be to the advantage of the electric lighting industry all over the country, if some sort of committee could be formed to draft a set of rules of some sort, it could be made a standing committee, whose duty it should be to consider and revise the rules from time to time, then we would have some rules that would obtain not only in New England, but in California, and even in Chicago; that is exactly what we ought to have. When we first started the method of examination in New England, we had a different inspector for each locality, one at Boston and one at Portland, Me., New Haven, Springfield, Mass., and at Providence. What was the result? A party installing a plant in Maine was subjected to one set of rules; when he went to New Haven or Providence or anywhere else, he had to conform to a different set of rules, and

that is the condition of things all over the country to-day. We ought to have some general rules so that the party installing in New England would meet the same rules when he went to any other part of the country. I would like to see a committee appointed for that purpose, and I would like to have a good part of that committee made up of insurance men, who are the only men who can enforce any rules you make. You must work together with them. I would have a certain number of practical electrical experts on the committee, and those men could be selected, one or two by this Associtıon, and one or two by your sister Edison Association, and let the committee be large enough to cover the whole country, and small enough so as not to be cumbersome, and let it govern the question of rules, and let those rules be condensed and solidified and brought right down to what is useful for safety, and then have the rules so framed that the insurance inspector who can tell you all about everything, except electricity, can understand them. Then you have men spread all over the country to see that those rules are enforced, and before you know it, you will not need any further inspection. You will have, then, a great governing committee, who will stand behind this national committee on rules and amend them from time to time as need be, and the committee will be useful in many ways. Going back to the subject of mutual insurance, I want to impress upon you the importance of the fact that the inspectors of your mutual insurance company will be excellently qualified to give valuable ideas to the insurance companies. The company wiil break down all the barriers of prejudice. It will show to the country that you are not afraid to insure your own plants; that they are not those terribly hazardous fire generating establishments that they are commonly understood to be. I hope that the recommendations of the committee will prevail.

THE PRESIDENT: Knowing the good work done by the New England Exchange, and fully appreciating the importance of the work of this committee for the electrical interests of the country, the Chair has allowed rather a wide latitude to the discussion. We have with us Captain Brophy, of Boston, of whom we have all heard much, and I am quite certain from whom we would like to hear more on this occasion. Mr. Brophy, have you something to say?

Captain Brophy: Mr. President and gentlemen of the Association: I am pleased, as one who has no pecuniary interests in any electric lighting company, to have the privilege of saying a few words to this Convention. I began, as you know, with the New England Exchange, four years ago, to supervise and examine the work done by electrical people. I am happy to say, that from the start I had the hearty co-operation of every man engaged in that business. We have done, I think, a work that has been of exceeding great value to the electric light fraternity in New England. I think, any one here, who represents New England, will bear me out in making that statement. The insurance people were entirely ignorant of this new element that was introduced into buildings that they insured, and naturally were wary of it. They felt that it was no part of their duty to maintain this inspection at their expense, as all of the risks at that time were insured and rated before electric light was introduced, consequently, they made arrangements with the electric light manufacturing company to bear a portion, and a large portion, of that expense. They did so reluctantly at first—they did so with a great deal doubt. To-day, more than one of them have testified to me that the expenditure thus made, has been returned ten, yes, a hundred, fold. (Applause.) We have been exempt from injury to life and person in a remarkable degree. The three or four accidents that occurred there, occurred purely and simply on account of the negligence and recklessness of the unfortunate victims. Our losses from fire have been so insignificant that they are not worth hardly anything so far as the loss to insurance companies was concerned. I wish to state here emphatically that the report made by the worthy fire marshal of the City of Boston to the board of alderman, that in his belief the disastrous fire of Thanksgiving Day was due to electric wires, was made without due deliberation and with a wonderful lack of necessary information. Any one who knows anything about the condition of affairs there must know that that was not the cause of that fire. I certainly do, and if I had any respect for the electrical knowledge of the worthy fire marshal of the City of Boston, previous to his report, I have since lost it. (Laughter.) Now, something as to the work of the New England Electric Exchange. I was one of the promoters of that institution, I did all I could to force it into

existence. Some vigorous English I made use of at a meeting brought forth that child. Now, as to Mr. Smith's objection that a technical examination will not reach the moral character of the man examined, I will say that I know every man engaged in the electric light construction work in New England. They are all my friends, and when I find a man whose moral character or whose habits unfit him to be in a responsible position, I do not hesitate to tell him so in plain and vigorous English, if necessary, and withhold my signature from his certificate, no matter how great a knowledge he possesses or how expert a workman he may be, so that we have no trouble from that source. We have had since the organization of that exchange a set of men employed in construction work that in point of intelligence and in knowledge of their business cannot be excelled in any part of this country. The time is fast approaching when the duties of the inspector must cease in New England, unless he wishes to become a pensioner upon the bounty of the electric light fraternity, and he has not reached that age as yet. This is owing to the hearty co-operation of the men engaged in the electric lighting business in New England. As I have stated to our Executive Board, only a day or two before I came here, the work is now done so much better than when we began, that in many cases the duty of the inspector is simply a matter of routine; we have arrived at that happy stage by a rigorous inspection, by rejecting every piece of poor work that we could find, by impressing on the minds of those engaged in constructing work, the futility of attempting to palm off anything that was not first-class, and in all this work we have not been obstructed in the least by the men most interested—the electric light companies and construction companies. In regard to those men who spring up in every village, who have strung a telephone wire, or a bell wire, or a gas-lighting wire, and attempt to enter this business, we have a little rule that puts a stop to that at once; we issue a circular, giving the names of men authorized by the New England Insurance Exchange to do construction work. A man who wishes to get on that list, must satisfy us, beyond a doubt, of his competency and his responsibility, before his name gets on the list, and now, a party whose name is not on that circular, has rather a

poor chance to get rich in the construction business. There is a prejudice in the minds of the people that never should exist. Many people believe that death is present in every foot of electric wire. Many people believe that when it is introduced into their buildings, their property is liable, at any time, to be destroyed by fire. There is no just reason why this should be believed. The men engaged in the electric lighting business in New England are as honest and as unwilling to hazard the lives and property of any of their customers, as they would be to imperil their own, and the feeling that has been engendered in the minds of the public has been created largely by the sensational press of this country, and is one that never should have existed, and is a gross injustice to the men engaged in the business of furnishing the best light, except sunlight, that ever glimmered on the face of this earth. It is unjust that they should be subjected to such an outrageous raid on their business, by the sensational press of this country, by men who write articles but do not know the technical difference between a wheelbarrow and a dynamo. (Laughter.) The time will soon come when the inspector of the New England Exchange will have to find some other field in which to exercise his talents; the only regret he will feel will be to miss the friendly greeting he has received at the hands of the men engaged in this business. I feel, though, that in justice to the men engaged in that business, his duties will be no longer called for. (Applause.)

Mr. Smith (of Philadelphia): I am afraid I have not made myself as clearly understood as I should wish. I am not opposed to rules. The only objection I make to the rules is that they are too complicated. What we want is a few general rules of what should not be, rather than a great many small rules of what should be done.

In regard to the other point mentioned by Mr. Brophy, I am heartily in favor of having the insurance man the inspector. I believe there are many fires that are attributed at once to the electric lighting, when, if the building had been properly inspected, the accident would not have occurred. We have had three cases of that kind in the last two months. In one case, Mr. McDavitt went into a mill, the proprietor of which was in the state of mind that the public generally is, and thought he was

liable to burn out at any moment. The first thing that he saw was a large bundle of greasy waste, and he said: "You are in more danger from that pile of waste in one day than you would be from electric lights in 10 years." The man we want as inspector is a man familiar with fire risks of all kinds, and I think our companies at Philadelphia show an appreciation of that fact in making it a condition of subscribing to the expense of this inspection, that no matter how many other experts are employed, Mr. McDavitt shall be at the head of the bureau.

Mr. Williams (of Ohio): I would like to offer a few words, although I do not profess to any practical knowledge on this subject of insurance, yet I happen to be interested in several insurance companies, who, in the past few years, have had a large number of central stations on their books, and we endeavor to get them periodically inspected. We have found ourselves confronted with very many difficulties. We have found that while our directors in several companies were practical business men and manufacturers, earnestly inquiring into the advantages and disadvantages of electric light, yet the business itself has developed so rapidly that it has been almost impossible for us as a small combination of companies to keep pace with that development. I believe you will readily recognize the condition. Your committee to harmonize electrical interests with insurance interests is well named. I do not know whether it will ever be accomplished, perhaps it may be, certainly at present those interests are very directly opposed. As one gentleman has remarked, you ask for insurance on a station and the company simply says the rate is so much, without entering into any calculation at all. That is simply their position. If you don't like it you can go without insurance. On the other hand, our friends from the New England States have advanced very many strong arguments in favor of the reduction of rates. The question of the rate on the central station has not, it appears to me, been very much touched upon. There is this consideration that I would like to present. We are not altogether dependent in this country on the stock companies. I am glad to see that our friends have presented proposals for a mutual company. I hope it will crystalize into a good, solid, substantial company. The plans and purposes are in the direction of harmonizing those in-

terests. They have taken pattern from the New England manufacturers' mutual companies. Perhaps it would be well to look back to those companies, we may learn something from them. About 40 years ago, they commenced experimenting, and they have gradually followed it along, maintaining their inspectors and confining their operations mainly to the New England States, and now progressing out into the far West, and our Western manufacturers, recognizing the advantages obtained from their inspections, are writing their insurance with them very largely. But all this has been done at the expense of the insurance company. They started out on the basis of the rate charged by the insurance company for insuring their mills, and they charge the insurance at those rates. They laid down schedules, and they have gradually raised their standard until, to-day, after 40 years of experience, they are able to return to the members insuring with them, 75 or 80 per cent. of the cost. At the same time that basis rate has been reduced over 50 per cent., so that the cost of insurance as stated in this prospectus is correct.

Now, the New England Exchange—and I want to tender these gentlemen my most respectful acknowledgments for what they have done, and they have certainly done a great deal—followed in the steps of those New England mutuals in this matter. For 25 years these companies have been favored, and are now willing to step in and take the advantage of what the mutual companies have done. If we take the same ground the stock companies have taken, with the rates as they existed, it would take 25 or 50 years to accomplish it, because they don't want it. Those companies want simply to look back 25 years, or read the experience of the mutual companies, and it seems to me that to-day they are not progressive companies that could be expected to harmonize the interests of the electric light and the insurance companies. It seems to me—and you will pardon me for speaking as a mutual man, having spent some 40 years in it—it seems to me that they are altogether too old; they move slowly, and you want companies that will move with you in developing and progressing as you progress and develop.

On this matter of inspection, pardon me if I say again that we maintain a system of inspection. We insure only manufac-

turing classes, and, of course, our inspectors necessarily have to acquire some knowledge of the electric light system. We endeavor also to have those men specially instructed by our own inspector on that very subject of the electric light and its dangers. We cannot possibly enter into the installation of wires in other buildings. It is not a manufacturing hazard with us, and so with every other insurance company.

I take it that the question narrows itself down to the insuring of central stations and power stations; and if that system of inspection is to be adopted, it seems to me the only reasonable way in which it can be done will be at the expense of the companies. The central station should be willing to pay a fair rate at the outset, and let the insurance company get its statistics from the inspectors and ascertain the exact rate at which the insurance can be carried. That is the plan that has been followed successfully in the East, and I think it can be followed in the West. Then you avoid this necessity of educating inspectors. It seems to me if this Association were to undertake that, it would be a very hard question. Who is to educate your first inspector and your sub-inspector? You have a mass of work on your hands that would be interminable, and certainly would not tend to harmonize the insurance and the electrical interests.

The organization of a State Association seems to me to be in the direction of harmonizing those interests, but there are other things to be harmonized. If you organize a single company and send it out with the stamp and the endorsement of this Association, will that tend to harmonize the other companies throughout the country? Can the Association afford to do it? It is for you gentlemen to decide.

I would suggest that it would be, perhaps, well to find what companies would adopt that system of inspection, and whether that system of inspection would be such as would meet your own requirements, or whether those inspections would reach the standard that would be agreed upon by that committee on insurance. If that committee were appointed, it would be competent for them to ascertain such companies as would follow out that plan and give the members the benefit of the advantages of an inspection.

There is another question that would come before that com-

mittee. This is a progressive, developing business, and very many devices are being introduced from time to time. It is not merely a question of wiring. While I can endorse all that has been said by the gentlemen in regard to the defects of wiring, many devices are being introduced, some of them possibly very good, some of them excellent, and some otherwise, and yet they are put in and dependence is placed upon them, and the result is bad. That committee, it seems to me, should have before them also the question of deciding upon the value of these devices; for instance, the question of inside wiring. Very many methods are adopted. If the committee lay down a standard, which, of course, from time to time would be modified as the business developed, and as the means were shown, that standard would be raised and companies would be encouraged, and there would be advantage reaped on all sides. There would be a producing of harmony.

As to rules that have been spoken of, we are in favor of rules. We want rules. Nothing can work without rules, but they should be as simple as possible, and be reduced to a clearly understood basis. Those rules could be formulated in this Association from that committee, that should be composed of insurance and electrical men, and then every State Association could adopt them, and there would be no difficulty in arriving at a beneficial result.

There are very many other points in connection with this subject upon which I might speak, but the hour is late. I can only say that we shall be glad to aid in the organization of success to the electrical mutual. We will furnish the result of our inspections and will endeavor to ascertain the dangers, and we shall expect you to assist us in avoiding those dangers. (Applause.)

On motion of Mr. M. D. Law, of Philadelphia, the report was adopted.

MR. GEORGE E. PALMER: Mr. President, I do not know whether at this time I would be entitled to the floor or not, but with recognition by the Chair——

THE CHAIR: Proceed, sir.

MR. PALMER: I have listened with a great deal of interest to the discussion this morning, but it has occurred to me that The

National Electric Light Association are making the same mistake now that was formerly made in the American Society of Mechanical Engineers, and other societies to which I have belonged, to wit, an unlimited discussion of papers. It was found in these societies, that in order to get through with the business in reasonable time, and not tire everybody out, that remarks on papers, reports, etc., should be confined to five minutes by each speaker, so that all persons may be heard, and the business of the Association rapidly pushed through, and the business of the Convention not delayed so that it could not be closed at the proper time. If it is proper for me now, I wish to make a motion.

THE CHAIR: It is entirely proper.

MR. PALMER: I move that remarks in discussion of all papers, reports of committees, etc., be confined to five minutes to each person, unless other persons give the speaker their time.

THE CHAIR: On that subject I will say that a number of papers to be submitted to-morrow and the day after, have been printed for advanced circulation. We appreciate the value and pertinence of the point raised by Mr. Palmer to that extent, but it was an undertaking that could not be carried to apply to all of the discussions, all of the reports of the committee, and all of the papers to be submitted. We have attempted, however, to apply it to a certain extent. I think the point raised by Mr. Palmer is a very good one, and it is chiefly from the general discussion of a topic that benefit is to be derived, especially when that general discussion is brought out by a previous preparation in the way of thoroughly canvassing the report or the paper to be submitted.

The question being on Mr. Palmer's motion to restrict remarks in discussion to five minutes to each person, it was carried.

THE CHAIR: It is now a quarter to one o'clock, and at three o'clock sharp, it will be necessary for us to adjourn in order to catch this special train for Excelsior Springs, to which all delegates are invited. It is now incumbent upon the Convention to decide whether we will adjourn for lunch, or prolong this session and adjourn in time to get lunch before the time set for taking the train.

MR. HUNTLEY: I move that we continue in session and do not adjourn until two o'clock.

VICE-PRESIDENT DE CAMP: I move to amend that we now adjourn to meet again at two o'clock.

MR. PERRY: I very much doubt, from my experience, if we agree to meet here at two o'clock, that we shall meet here at that time. I move to continue the session until two o'clock.

The question being upon the motion to adjourn until two o'clock, a vote was had and a division was called for, which resulted as follows: Ayes 15, noes 17.

The question recurring upon the original motion to proceed with the session until two o'clock, it was carried.

Seeretary Garratt read the following paper, prepared by Mr. C. J. H. Woodbury, of Boston:

CONSTRUCTION OF CENTRAL STATIONS.

BY MR. C. J. H. WOODBURY, OF BOSTON.

While acting in co-operation with a Committee of The National Electric Light Association, several years ago, it was necessary to examine into the matter of the construction and surroundings of a large number of electric lighting stations. Although these stations were built for the same object, and contained machinery and motive power devoted to the same industry, yet there was a diversity in their characteristics which was wholly inconsistent with their similarity of purpose.

In accepting the invitation of your President to present a paper for consideration at this meeting, it appears that the subject of central station construction might be a profitable one—not by reason of what may be contained in such a paper, but on account of the valuable experience which would surely be offered by the members participating in the general discussion of the subject, and in such a connection this paper is to be regarded as the opening of the discussion, hardly more than a parliamentary necessity, in order to bring the subject into a debatable form.

Many of the electric lighting stations in large cities have been built under easy financial conditions, where it was feasible to adopt suggestions for convenience, strength and safety, offered by the engineers in charge of such work. Notable examples of such stations have been presented before this Association, or illustrated in the electrical journals. The opportunities for large stations have thus far been so few, and the governing conditions so diverse, that the problem requires in each instance an independent treatment, and is, therefore, unsuited for a general paper on the subject.

The larger part of the electric light stations are of moderate size, and were constructed under conditions of limited resources which often compelled parsimony in the reduction of first cost, and did not permit the exercise of that judicious economy which yields the greatest return on investments.

A most important element in the arrangements of a central station should be the guarantee of continuous operation, in order to give patrons a

necessary confidence in the stability of the service, which must be instantaneously equal to the maximum demands of customers.

Many of the stations are in close proximity to other buildings of a miscellaneous character, and are built with hollow frame walls and thin roof, forming a structure which is hot in Summer, cold in Winter, and combustible all the year 'round—which disadvantages diminish dividends.

The location to be desired for a station should be, first, away from a proximity to other buildings, and, therefore, free from a fire hazard due to surrounding exposures. It is important that the engines should be provided with an independent condenser, but it is not necessary that the station should be near a water course to obtain a supply of water for the condensers, as is the universal custom in this country. A reservoir of suitable capacity, and not over eight feet deep, will furnish a supply for condensers, which can be used over and over; the condensed steam and hot water entering one side of the reservoir, and the supply for the condenser being taken from an extreme side. If the water should not cool rapidly enough, it could be delivered from the condenser upon the top series of several nearly level platforms, thus flowing upon one and thence to the next in turn. In this way the water rapidly cools. Although the condensing capacity of such reservoirs might differ in this country on account of climatic differences from European practice, yet it is well to note that in Winter, when the short days cause the greatest demands upon a central station, the condensing capacity of such a reservoir would be greatly increased by reason of the more rapid loss of heat during cold weather.

In its general arrangements, a central station may be regarded as an engine room, and if well adapted to engines and the delivery of power, there cannot be much difficulty in providing accommodations for dynamos. The type of building suggested for consideration in its application to central station service in small cities, is the one-story slow burning construction, with flat roof, lighted by a longitudinal monitor, one end of which extends high enough to form a wire tower. It is not claimed that there is anything original in this design beyond a few minor modifications pertaining to its application to this specific purpose, for it is well known that beginning with one-story machine shops over twenty-five years ago, foundries, textile and paper mills, on the same general idea of construction, have been widely introduced, wherever the cost of land was low enough to permit the erection of a one-story structure without raising the whole cost of the floor area, including the expense of land, to a price exceeding that of a high building.

The question of foundations does not pertain to this paper, but the importance of suitable foundations is too often slighted.

Franklin once said that next to a good foundation, a good roof was the most important part of a house. The question of roof will next be considered, leaving the intervening pillars and walls for later reference.

The most convenient width for stations using an engine to every pair of dynamos is forty-three to forty-five feet, and the length of the station is in proportion to its capacity. The roof should be of three-inch plank, each

twenty feet in length, grooved and splined with hard wood splines one-half by one and a half inches, and laid on roof timbers breaking joints every three feet. In colder parts of this country, liable to temperatures below zero, it is good economy to lay a course of inch boards upon the plank, with roofing felt between. Pine is preferable to other lumber for roofing, as it does not warp so much as other soft lumber, and the roof covering will last better. The roof covering may be of any material for covering flat roofs, but its value will depend upon the quality of the material and the character of the work.

If these methods are followed, such a roof can be relied upon not to give trouble by condensation of moisture in cold weather, but care must be taken not to drive nails up into the plank, because being good conductors of heat, the heads would be cool and moisture collect on them.

Along the middle of the roof, a monitor ten feet wide, extending to twenty feet from the ends, will afford light and ventilation, while an extension of this monitor at one end to a suitable height will form a most convenient wire tower, if the monitor, in connection with an outrigger, should not be high enough for the purpose.

The roof timbers should be of southern pine, ten by twelve inches, and laid ten feet on centers. They should project eighteen inches beyond the walls, and the ends be cut to form brackets supporting the overhanging roof and forming a solid cornice. At the ridge, the two beams should be secured together by a junction bolt, and supported by column and bolster.

The walls of the station may be built of brick or of wood. If of the former, a twelve inch wall will answer, with windows arranged as may be desired ; but if of wood, each roof timber should be supported on an eight by eight inch timber reaching to the sill, and secured to the roof timber by an iron brace, and to the floor timber by iron dogs.

If the building is to be used for apparatus generating low tension currents, the best floor would be made by laying coal tar concrete on a foundation of broken stone or cinder, and then laying three inch plank upon the concrete, and covering this plank with one and a quarter inch hard wood plank laid across the bottom plank and blind nailed to it. Such a floor would sustain any weight liable to be placed upon it, but where there is need of a mass to hold rapidly moving machinery, it could be cut away wherever it might be necessary to lay heavy foundations.

On the other hand, if the generation of high tension currents in the station imposed electrical conditions requiring a higher insulation of the floor, such as could be obtained only by an air space underneath, then it would be necessary to enter into a larger expense, and to lay a mill floor by placing the two thicknesses of planks on beams in a manner similar to the method described for the roof.

If the dynamos were placed on independent foundations, this floor would be strong enough, but if it should be required to sustain very heavy loads, there should be a line of piers supporting the beams under these loads. The lower portion could be made into a supply room ; or otherwise, the front of

the building could be divided by a light sheathing partition into a supply room and an office.

In its appointments, the building should be heated by two coils of three lines of one and a quarter inch pipe, each hung about three feet below the roof timbers, the arrangement of piping using exhaust steam for such a building being about one foot of one and a quarter inch pipe to every seventy cubic feet of space. Two coils are suggested, because the side occupied by the steam engines would rarely need any heat from the pipes.

The roof timbers afford easy means of securing a trolley track for making any changes and removing the apparatus or parts of the engines.

The protection against fire consists principally in keeping the establishment in a clean and orderly condition, the use of good lubricating oil and careful attention to the bearings; and beyond that, numerous fire pails kept filled with water, and hose connected to hydrants ready for instant use, form the means for protection against fire.

If the boiler house is placed at one corner of the station, the latter can be extended by increasing its length; but if the boiler house is placed at the end of the station, the division wall should be made of brick and extend through the roof, entirely cutting off all wood communication between the station and the boiler room.

The wires could be run from the dynamos diagonally upward to the roof timbers, thus clearing the trolley track, and thence under the monitor from beam to beam to the switchboard on the floor under the front end of the monitor which forms the wire tower. This switchboard would be at the end of the unavailable floor space used for belts, and being in the middle of the room is away from the walls, where any combustible material is likely to be placed. It is important that the switchboard should be made of soapstone or other incombustible material.

It is submitted that a station built in accordance with these general suggestions would embody the merits of convenience in operation, slight need of repairs, and, whether built with brick or plank walls, would possess a resistance to fire which would reduce the fire hazard to a nominal amount; and although not so cheap in its first cost as might be made by using a lighter construction, yet, as a whole, it would conform to the strictest conditions of economy in a building to be used for a central electric lighting or power station.

MR. PERRY (of Providence, R. I.): Mr. President and gentlemen of the Convention: A few minutes since, the President told me personally that he had written me a month ago to be prepared to open this discussion. I am glad he told me of it. (Laughter.)

The gentleman who has carried the resolution limiting remarks to five minutes will also take notice. (Laughter.) It seems to me that this paper might be more properly entitled

"Permanent Construction of Central Stations." It is about time that we began to look about and consider what sized central stations we shall have, and where we shall locate them, with a view to permanently develop the business of producing electric currents, to be distributed for whatever purposes used throughout the communities where we are severally interested in this business; and it is possibly on that point alone that I shall offer a single suggestion.

I think I speak advisedly when I say that almost every central station man throughout the country has set down, finding his station too small, enlarged it to meet the requirements of all time, got it not quite completed, and found it was still too small. (Laughter.) I think we have rebuilt three times, but the last time we determined to settle that matter for a considerable period, so we bought a plot of ground, 200x300, covered it about half, which, with the ordinary 50-light machine, would develop the dynamo room, which is 60x200, so that we would easily handle the 4,000 lights in our city. We find now we have got to just duplicate that.

I think there are some general lines on which it is safe for us to proceed. It is a very important point, if possible, to so locate your central station, that if you are inland, near a railroad, you can run a track in and switch your coal right in by the car, or if coal transportation can be reached by water, you can locate as near the water as possible and get the advantages of water transportation.

A suggestion has been made here—how that can be accomplished if you are located inland—to locate near the water-side so that you can erect your apparatus right alongside of the station. But the one great important point is to determine how large to build the station, that it may permanently serve its purpose for not less than 25 years, in the development of this business. One of the ideas that suggested itself to me was, in solving this problem, to take the total gas output of the city, and on the basis of 16-candle lamps, reduce it to steam power and provide for from two to three times the total gas output. Speaking to you as intelligent men, I would say, buy your land now for the buildings you will erect in the future and you will find it much cheaper. You will save more than six per cent., I

will be bound, if I am any judge of human nature. No matter how public spirited your neighbor may be, he will want a good round price for his patch of land. It seems to me that when you have selected your plot of land you can build on some general lines and lay out your station to cover the whole plot and then leave a portion of it so that it can be added onto and in the end be a completed station. So far as we know, to-day, we have got to rely on steam-power. It seems to me the only thing we can absolutely stand by. There are a good many things in the air. You can say what you please about raising chickens from feathers, but when you really want chickens the best thing you can do is to depend on the eggs. (Laughter.) You can safely buy up all the eggs and the chickens will come in time.

Now, a word in regard to boilers. Locate your boiler to develop this whole plot of land. Make arrangements with your engine for that purpose. Then put in your first ones and follow that out on these general lines. Now, the question as to engines is a very important one, and as we know, is a very much discussed one. My idea about that is, that, when you have determined by that rule of taking your gas outputs, provided, of course, that your community is using gas extensively, you should take that gas output and multiply it twice or three times, as you have the courage to do, and then make your preparations to supply that amount of electric current, and divide that into about ten units. Those ten engines are equally adapted to delivering the power on jack-shafts and belting up overhead, which I believe, is the best way. By and by, when you get along with your unit as a 1,000 horse-power engine, you can drop your jack-shaft and belt right up to the engine.

As to what engine to recommend, I do not believe that I shall attempt to offer any suggestion on that point. After a careful investigation of the whole matter, and consultation with some of the more prominent mechanical engineers of the country—expert engineers—we decided to adopt, and have erected a triple expansion engine, built by Allis & Company, of Milwaukee; designed by Mr. Rugles, the superintendent of the works. We have had it in operation now for about four months, and we have never had the slightest trouble with it. It has done admir-

able service, and, although it has not yet been tested, it gives great promise. Whether it will reach the very low duty which has been guaranteed, is a thing which Mr. Leavitt, of Cambridge, will determine. I have invited him to make a test, and he has accepted the invitation. I should not be surprised if we got at it within a month. It is a large plant, and we are tightening up the lines now, and shall be able to make the test very soon.

The type of boiler is a very difficult thing to determine. They are very much alike, and it makes very little difference, so far as the evaporation of water is concerned. A four inch tube, whether it comes from one factory or another, will do the work.

One point I wanted to emphasize, was this: When you set about constructing your station, it should be of a permanent character, and there should be made very large and liberal arrangements for the growth of your business. If that is neglected, there will be a universal inconvenience, which has already been suffered from starting up in a hen-roost (laughter) or under a shed outside. I believe the loss of money in this direction is greater than any other in central station experience. The fact is, the day has gone by for that sort of thing, entirely. The man who had a common buck saw, or wood saw, would carefully grease it and wipe it, and hang it up on a nail in a dry place, but he don't hesitate to pay four, five, or six thousand dollars for an incandescent light plant, and then stick the whole thing out in a shed, almost without cover from the weather. The thing is so utterly absurd that it is hardly necessary to discuss it.

The strong point I wish to bring out is the providing of ample space or ground. Buy it and own it. It is what you want for future growth and development. That is certainly a pertinent lesson, that has been taught us by the universal experience of all men engaged in central station construction. (Applause.)

Mr. M. J. Francisco (of Rutland, Vt.): I would like to ask the speaker if he recommends independent condensers? Has Mr. Perry had any experience in running an independent condenser?

Mr. Perry: We had designed for our station an independent condenser, operated by an independent engine, and it had some

unusual features. It is the first cut-off cylinder that was ever put on a condenser that I know of. We have been operating with that since about the middle of December, and it has been very satisfactory. We have a guarantee as to the steam or water consumed in developing a certain amount of power, so that it is to be brought down onto the same level of economy as the main engine. The condenser which we are operating is a condenser designed to handle easily 2,000 horse-power. Our first engine is in and we have worked it up to 750 horse-power, and have never had a minute's uneasiness. It has never been shut down for an instant. It has operated so satisfactorily, that we have now contracted with the builders, and they are at present constructing for us another engine of the same stroke, the same diameter of fly-wheel, and intended to drive on the same shafting up to 1,500 horse-power.

THE PRESIDENT: As the next paper is upon a kindred topic, the steam engine, before closing the general discussion upon this topic, we will hear from Mr. Fred. E. Sickles, of Kansas City, upon The Steam Engine.

Mr. Sickles then addressed the Convention on the subject of The Steam Engine, as follows:

THE STEAM ENGINE.

The theory of the steam engine has been so fully explained and is now coming to be so well understood, that it is scarcely profitable to take up time in reiterating it here; but there are some mechanical defects in the steam engine which are yet to be remedied, and which it may be well to mention. I shall not mention any one device which is covered by any patent in anything I have to say here now.

Every device that has yet been used to admit the steam and to exhaust it from the cylinder, under the general name of valves, have had their special defects. The old-fashioned slide valve, involving a great deal of friction, and while this is meant to be remedied by balancing the valve, contrivances which have been applied to this purpose, though more or less complete, have not yet balanced the valve, as the pressure upon it varies with the position of the valve, and all attempts to balance the old-fashioned slide valve with the rigid fit without elasticity or some yielding arrangement have proved a failure, as in first applying the steam and warming the engine, the valves will warm faster at first than the surrounding steam chest, and will jam if care is not taken to give ample time for the equal warming of all parts; and any want of care on the part of the engineer in this respect will tend to work injury by the cutting of the valve when first starting the engine. In that

form of piston valve which has piston range, either one or two, the liability of leakage past the ring is encountered, especially as those rings cross the ports of the cylinder; when attempts are made to work pistons with solid rings, then the difficulty of expansion is encountered. If a solid piston is used in the piston valve it becomes necessary to make the piston slightly smaller than the bore of the seat to allow for the unequal expansion when first starting the engine.

The many ported slide valve gives ample opening with but little motion, but it has extended edges to permit leaks if not carefully fitted. The rotating slide valve with a raised seat is difficult to get at to keep tight, although it presents some advantages in connecting the valve motion to it. With balanced poppet valves the difference of expansion between the valves and the chest is liable to create a leak, but if great care is exercised in fitting this kind of valve and an ample guiding surface is allowed above and below on the stem, and the seats are made of not more than an angle of 22 degrees from the vertical line with the valves and chest cast of metals of substantially the same rate of expansion, the valves can be made to remain reasonably tight. Yet, if great care is not taken in the adjustment and shape of the rock shafts for opening and shutting the valves, they are liable to make an unpleasant noise when running at any rate of speed. The single poppet valve can readily be made to work tight for a reasonable length of time, but it has the same objection as the double poppet in regard to making noise at high speed, and in addition to this it requires heavier valve gear, because, just at the instant of opening it offers great resistance. They do not waste, as a whole, as much steam as the double poppet valve. They can be arranged to have less clearance between the cylinder and valve. Indeed, single poppet valves have been placed directly upon the cylinder heads, thus giving very slight clearance. This plan has not come into use, owing, probably, to want of proper adaption of the details of the mechanism. The whole subject of valves for steam engines presents a field for ingenuity.

It may be expected that the speaker will give some account of the trip cut-off valve, with which his name has been identified for one-half of a century. To do so fairly I shall have to state the requirements of a perfect cut-off, which really cannot be secured, and the trip cut-off is only an effort to reduce the loss occasioned in working the cut-off. To describe this loss I will state that steam may be assumed to have two different powers. One power is derived from the force it exerts in pressing against the piston as it escapes from the boiler into the cylinder. The other is the force it exerts after communication has been cut off between the boiler and the cylinder in expending and continuing to exert a diminishing pressure upon the piston. When the steam has exerted, say, nearly the whole boiler pressure at one-fourth of a stroke, and it is then desired to cut off the steam so as to obtain all the power that can be derived from the expansion of the steam already in the cylinder, the communication between the boiler and the cylinder would have to be instantaneously closed, so that the power derived from expansion in the cylinder might begin at nearly the boiler pressure and continue to exert a dimin-

ishing force to the end of the stroke. Any mechanism yet devised cannot instantaneously close the opening, for two reasons: First, it would be impossible, as far as we know, to put any machinery in motion sufficiently rapid to instantaneously close the opening; and, second, if this rapidity of motion could be obtained, it would be impossible to absorb the momentum of the parts in arresting this very rapid motion. The best we can do in this regard is to devise some arrangement which will move as fast as it is practicable to move mechanism, and then absorb the momentum of these parts in such a manner that no destructive violence will occur in arresting their motion. In the trip cut-off, the valve is liberated from the opening mechanism and is forced shut by a spring or elastic force, as shown in the original patent; and, in fact, in the original patent the elasticity of the spring and the elasticity of the steam are both used to force the valve shut as rapidly as it is practicable to do so. The mechanism for absorbing the momentum of the parts may be explained by referring to what we see every day. We see that water and air in their action upon the earth disintegrates and destroys its surface, in time, while neither the water or air is injured by the violence. All the storms that have beaten upon the ocean have not injured one drop of water, while the air and water have washed and disintegrated the shore line of all the continents. Hence, it is reasonable to infer that if the violence of the momentum occasioned by the use of the trip cut-off on rapidly closing could be absorbed in the motion of a fluid, whether water or air, a practical working machine would then be secured. It is only necessary that the valve in closing shall work some device like a plunger or piston which shall have this property, viz.: That it shall move freely in the fluid while the cut-off valve is closing, but at the moment of the closure it shall encounter the fluid by confining a portion of it. How is the power lost in the case of a locomotive that at one minute is developing 400 horse-power with full boiler pressure and having been suddenly flagged to stop, is during the next minute exerting no power through the cylinder (in the meantime the pop valve has jumped wide open, and steam is escaping violently through it)? The power of the steam is lost after the engine is shut off in forcing the particles of steam past the blow-off valve into the open air. In the same way, while the cut-off valve is slowly closing, the power is absorbed in forcing the particles of steam past the cut-off valve. It might be well for those who have yet to believe in the efficiency of the trip cut-off, and among these are some of the very best mechanics of the present day, to try the part which I presume they will have the most doubt about, that is the checking apparatus or dash-pot. If they will make a controling vessel so arranged that it will permit the fluid to escape freely, until it is desired to arrest the momentum by confining a portion of it, and forcing it through a narrow orifice of any sort, and will watch its action by letting it run in a shop or other place for any length of time, they will be entirely satisfied as to the reliability of the checking apparatus. In regard to the tripping apparatus, one objection is the use of a spring in the valve motion of a steam engine. It may be well to mention that it is not necessary to have a spring, as a weight will answer to re-engage the trip, or a positive motion

can be secured; but springs or weights are generally used, and as springs are shown in the original patent, it may be well to consider the question of springs. The elasticity of metal is one of the laws of metals, as fixed as the law of gravity, and much of the prejudice against springs has been created by using them beyond their safe elastic limit; and when this is done, then the spring becomes an unreliable means of working mechanism. This fact may be illustrated by referring to an ordinary watch. The mainspring of the watch frequently breaks, but the hair spring, never. Yet the hair spring is put in tension and compression from three to 500,000 times in 24 hours. And the reason is, the mainspring is taxed beyond its safe elastic limit and the hair spring is not so taxed. In cases where springs are used, if this consideration is kept in mind, the spring can be made reliable within a reasonable limit. By applying this made of reasoning to the trip cut-off, the remedy is obvious. The force necessary to re-engage the catch is so very slight, it is quite easy to make a spring that in performing this office, while not nearly taxed to its safe elastic limit, it can, therefore, be relied upon with reasonable certainty, to work the catch. If any good mechanic may yet be in doubt as to its certainty, it is an easy matter to add another spring and catch, so that one will act in case of failure of the other. This was the plan adopted in the original patent to overcome one objection that was anticipated against the use of the spring in working any part of the valve motion in the steam engine. An examination of the model in the Patent Office, under date of May 20th, 1842, will show these double springs. It is difficult to change the opinion of any mechanic, except by illustrating. As there is now no patents upon it, it is public property. Probably the best way for inquiring engineers would be to test the catch or checking apparatus, and it will be found that they are entirely reliable as a practical question.

In cases where the trip cut-off is required to act at all points of the stroke, it is best to use it in connection with the patent of September 19, 1845, granted to the speaker, which has been variously termed "independent motion," "universal motion," etc., as it works the trip at any point of the stroke of the engine. This invention is in use on the steamers of the Fall River Line, running on the route between New York and Boston, and many other vessels. It has lately been used on some boats on the Western rivers under various names. When the trip is worked by the valve motion, as shown by the patent of May 20, 1842, it is best to limit the motion of the tripping piece so that the cut-off will always act, and not allow the steam to follow the full stroke by the excessive vibration of the governor.

The speed at which a trip cut-off can be made to work will depend somewhat upon the arrangement of the mechanism. The lighter the parts involved in the motion, the more rapidly they can be made to work with ease. A large steam engine, with large heavy valves, has been made to go at a rate of 120 revolutions per minute, and, indeed, it would be hazardous to limit the speed at which a trip cut-off can be made to work, as with the proper closing force and the proper absorbing vessel for the momentum, the speed of closing can be carried far beyond anything yet in use. But the cut-off is

only a part of the engine. The motion of the steam valve in opening to work smoothly with the greatest power should be such that while it moves to give only a slight opening at the beginning, so as to gradually apply the steam as the engine passes the center, this gradual opening should change into a rapid one, followed by a rapid motion of the valve in cutting off the steam. The motion of the exhaust valves should be rapid in opening and rapid in closing, and one exhaust valve can open before the other closes, providing some means are secured to gradually apply the steam at the engine as it crosses the center. But in practice there are only a few instances in which this gradual application of the steam has been used. I will mention one case in the speaker's practice. The steamer "Pilgrim," having an engine with a diameter of cylinder of 110 inches, and a stroke of 14 feet, carrying pressure of steam as high as 45 pounds per square inch, was required to be altered from a Stevens valve gear to a trip cut-off, and it was necessary to retain the faulty steam connection between the boiler and the cylinder and the faulty surface condenser, and to do the best the circumstances would permit. To remedy the faulty condenser in part, the exhaust valves were arranged so that one was open four and a half inches before the other closed, to afford the greatest possible time in which to condense the steam from the cylinder, and this prevented any attempt at cushioning. It was necessary, in working the steam valves of the new arrangement, to so graduate their opening at the beginning of the stroke as to avoid any shock or jar that might come upon the engine by reason of the application of steam. As the valve gear was very heavy, involving tons of metal, the spring of these parts would tend to increase the sudden admission of steam, notwithstanding any gradual movement that might be attempted upon them, a plan was resorted to of opening the steam valve an adjustable distance, say one-eighth of an inch, and then stopping all further motion for a short time, so that the spring of the heavy parts of the machinery should not act by their elasticity to increase the opening. After the engine had crossed the center, the further opening of the valve was commenced and continued until the cut-off acted. The entire distance of opening of both steam and exhaust valves was six and a half inches in this case. The indicator card still showed a defective condenser and defective steam connection, and it also showed what appeared to be a slight cushioning; but this appearance was deceptive, as the real cause was, the steam passed around from one side of the piston to the other, as one exhaust valve opened rapidly before the other closed, and the slight delay occasioned by the use of the faulty condenser increased this apparent cushioning upon the card. There could be no cushioning, because both exhaust valves were open, until the piston arrived at each end of its stroke. But the problem of applying to an engine of this size in the hull of a steamer, without creating a jar, had to be solved, and this was done, as before stated, by a careful adjustment of the steam valves in opening, so as not to apply the whole of the pressure at once. The first admission of steam in this case is marked by the sound of a squeal, indicating wire drawing at the first motion of the steam valves. The indicator card shows a curved line on the

admission end, proving the gradual application of steam. This was the best that could be done under the circumstances, and it was found effective in making the engine work smoothly while the main connections were quite loose, and saved a large amount of fuel by the rapid cut-off. No doubt she may still be seen running in the Summer, between New York and Boston, on the Fall River Line.

Any inquiring mechanic who desires to test the question of whether it is possible to prevent a jar by the gradual admission of steam, can do it in this way: He may put a very small valve upon one end of the cylinder of a steam engine, and make an arrangement to give it an opening and closing motion. Then, if he will set this engine to pound on both centers, and subsequently adjust the opening of this valve, he will find that it will take the pound off of one center, in which it admits steam, by properly adjusting it, and in this way be convinced of the efficacy of the gradual application of steam to prevent a concussion upon a center. Mechanics, as a rule, must depend upon themselves. The assertion of a fact by another is no proof to them, and hence I have stated a way in which they can satisfy themselves of the efficacy of the gradual application of steam. There are, however, many forms of valves in which this method of the gradual application of steam cannot be well embodied without too much complication, and for very large engines it might be well to apply separate small valves to ease the engine on the center.

In most cases, dependence has been placed upon what is termed, "cushioning," to make the engine work smoothly, by shutting the exhausts before the completion of the stroke and allowing the steam yet remaining in the cylinder to be compressed. It may be said that all high speed engines of the present day use this plan to avoid pounding on the center. Locomotives and high speed stationary engines depend upon the compression of steam to avoid a pound in the reciprocating parts. This compression necessarily absorbs a certain portion of the power of an engine, but it can be relied upon to secure smooth working. The price of coal, the interest upon the money and the cost of reliable attendance, are to be considered in determining the best plan as a money consideration. This last remark is true in considering the construction of every part of the engine. A perfect valve has not yet been made; a perfect cylinder has not yet been made; a perfect packing of cylinder has not yet been made; a perfect valve motion has not yet been made, etc., etc. The packing of the piston should be such, as that it will work without friction, automatically adjust itself to the wear and to the irregularities in the bore of the cylinder and also to the different temperatures of the piston and cylinder upon first starting the engine, and it must be tight. If the rings are made (as the speaker has sometimes done) with an adjustable catch to hold them from being thrust out by a spring, so hard against the cylinder that the steam could not force them back, then as soon as any wear takes place this catch will act to prevent the rings from following out the wear, and thus a leak will be created. Great care is required to manage an adjustable catch. Now, if the catch is not used and some force applied to keep the rings out against the cylinder, as is usually the case, then

if the steam leaks by the rings and gets between the cylinder and rings, it may force the rings back and create a leak. If the spring is set so as to hold the rings out against the cylinder and to resist the tendency of the pressure of the steam to force them back, then a great friction will be encountered between the rings and cylinder, and if the steam should pass behind the rings, it will force them out against the cylinder with additional pressure and thus add to the friction. If an arrangement, such as has been made, is used to present a smaller area to the steam behind the rings, than exists on the face of the rings, then the steam in passing behind the rings and forcing them out may be met by the steam which has passed down between the rings and cylinder, acting upon a greater area may overcome the steam forcing them out and force the rings back, thus creating a leak. Indeed, it may be said that mechanics are almost in despair of producing a perfect piston packing. They have turned grooves in the piston, and in these grooves have inserted other packing rings, but after all the difficulty exists in, that the steam is liable to force them in or out; if they are forced out it creates undue friction; if forced in, a leak is permitted; if any attempt is made to have a fixed ring in the sense of preventing it from being made either larger or smaller, then the danger of more rapid expansion of the piston is met upon starting the engine, also the difficulty of obtaining proper adjustment with ordinary attendance is met, so that a perfect piston, one that is automatic in its adjustment and comparatively frictionless and tight, as before stated, has yet to be made. All parts of the engine are imperfect. A realization of the imperfection of any machine may lead the way to make an improvement upon it, it is, therefore, instructive to search for defects in the steam engine.

A perfect lubricating arrangement for the journals, one that can be relied upon in all cases, has yet to be made. Of all the various forms of valves, each has its particular disadvantage, and there yet remains to the inventor a wide scope in which to engage his efforts. But in determining upon any plan, he is met at once by the consideration that a plan that might be good in one place, would not be good in another, because of the difference in the interest on money and the price of fuel. And, perhaps, in another place, the difference in the price of fuel and the price of efficient attendance. In another place, the difficulty of securing proper repairs, as, for instance, an engine in the mining regions. So it is quite impossible to give any specific directions for the construction of what might be called a universal steam engine. Perhaps, in some future day, some one will make a steam engine which will secure fully, economy in construction, economy in regard to fuel and efficient attendance, but certainly no such machine has yet been made.

As the cost of efficient attendance diminishes, probably an increase of efficiency of the steam engines can be secured. A machine that will work well in the hands of one person, will sometimes prove a failure in the hands of another, and a construction engineer is constantly harassed by the question, "Who is to take care of and run this engine, which I am now planning?" and, "How far can I rely upon efficient attendance?" and as often as he decides these questions, he decides, to some extent, the character of the engine which

he considers best for the purpose. Users of steam engines naturally desire to have their engines so constructed that they need not continue in their employ any particular engineer, but can change employés without danger to the success of their engines. Users consider this fact in determining the kind of engines to purchase.

A perfect governor for general adoption has not yet been made. All forms of governors in use depend for their action upon the change of speed of the engine, and when a small amount of steam is required to drive the engine, the governor must necessarily move faster to diminish the supply of steam, either when applied to a cut-off or to a throttle-valve. When the governor receives the impulse to run faster, the working parts of the governor are restrained, to some extent, by the force transmitted through them to increase its speed, and hence, at that moment, it is not as free to act as it would be if no such resisting friction was applied to it, and yet at that very time the governor is required to move, and the result is, it does not move at first, until sufficient additional speed has been imparted to it to overcome the friction created by applying the force necessary to create this additional speed; and when the governor moves, the friction having been diminished by reason of the driving force being less, it has a tendency to move freely and shut off the steam to too great an extent. Various appliances have been made to correct this by preventing the governor from moving rapidly in any case, but when this is done, the governor may not move with sufficient rapidity to check the engine when the load is suddenly removed. Then again, the parts which have to be moved have more or less friction in themselves, and the greater this friction the greater the tendency to obstruct the free movement of the governor. We see in practice that unless a comparatively large amount of momentum is secured either by high speed or by a large fly wheel, there is a great tendency of vibration in the motion above and below the required point. To overcome this, the speaker at one time combined a governor arranged to receive its impulse through a driving arm or roller so as not to materially impair its sensitiveness, and then this governor acted upon the differential motion patented by the speaker, which, in fact, separated all the force necessary to work the parts operating on the governor, and thus the governor was as sensitive as the pendulum. But this arrangement was too delicate for ordinary attendants, and was only resorted to in this case because of the peculiar surrounding circumstances. The patent on this arrangement has expired. It may come into use in some future time when the advantages of a very accurate running engine are more appreciated, and when the cost of efficient superintendence is less than at present. I may mention, so perfect was this engine, that on one occasion, when the driving belt broke, the engine continued to run so nearly exactly on speed that the difference could not be noticed. It is possible to make an engine do this, but it requires great care in the construction of the parts of the governor and the differential motion and power cylinder attached to it. It also requires that all the incidental slack that may be in the parts between the first motion of the governor and its final application through the differential motion and power cylinder,

shall be provided against by either a weight or a spring, which shall hold all this slack constantly in one direction, for this slight slack will still affect the action of the governor if it is allowed to act irregularly. Perhaps the best practical solution of the governor question at present, is to provide a very large governor running at high speed, so that a very little change in the motion of the governor will effect a very great change in the amount of steam applied to the engine; then, if this governor is driven by arms which bear against rollers inserted in the balls or weights in the case of centrifugal governors, so that these arms drive the balls or weights faster or slower through the interposition of a delicately made steel roller that permits the balls or weights to move freely when any additional force is applied to them, a much greater accuracy of regulation can be obtained than is usually found in practice, provided care is taken that all parts necessary to be moved to control the motion wheel have very little friction. It would be difficult to explain the whole matter without drawings, but I have endeavored to state the principles, which can, of course, be carried out by different mechanics. Governors for steam engines have been made in various ways, but nearly all of the kind which I am about to allude to have passed out of use, and I can best describe them in a few words by stating the principle upon which they were built and leaving the special designs out of the case. One form of governor was made by first generating a uniform motion, and this uniform motion was generated in different ways by different persons. One used a uniform motion acting upon a uniform resistance; another used a varying force upon a varying resistance and secured a nearly uniform motion by a governor; then this uniform motion thus generated was applied to control the motion of the engine, by interposing between the uniform motion and the motion of the engine, a lever or cam so arranged that the steam engine varying this lever or cam, in shifting its position, would apply more or less steam, and thus the engine was controlled to run with the speed of this independent uniform motion. Another form of governor was made on the principle of moving a body in a fluid, and as the resistance increased, by reason of the increased velocity of the steam engine, a spring or weight was moved, and by its motion the admission of steam was adjusted to control the speed. But it is questionable whether it is not the best principle to have what amounts to a substantially powerful governor, as before stated, so that a very slight motion of this governor will be sufficient to regulate the admission of steam to control the speed of the engine, care being taken to secure almost frictionless action of the governor in its movements, and to separate any load involved in the action of the parts to control the steam, so that the governor may act as nearly as may be like a pendulum beating time. And, indeed, the point to be reached, as before stated, is to cause the governor to be as sensitive as a pendulum of a clock, and to be free from disturbing influences.

Governors have been applied to cut-offs from the early part of this century; as early as 1812. As the trip cut-off required but little power to change the rate of expansion, it was well adapted to be operated by the governor, and its frequent use for that purpose has stimulated users of the different kinds

of cut-offs to connect them to the governor with more frequency than was the general custom before the trip cut-off was invented. Almost any form of cut-off can be controlled by the governor, provided, changing the cut-off does not bring too great a disturbing force upon the governor.

In regard to the steam engine of the future, if a metal is found that will enable steam of, say, 1,000 degrees to be used, and the escaping heat from the first boiler to be used in evaporating water to feed a second engine at 500 degrees, and then to a third engine that will make the draft by drawing the heated products of combustion through water, whose evaporation will supply a working cylinder that derives its power by receiving the steam below the atmosphere pressure and expands it to the lowest effective limit before discharging into a condenser, then we will have a combination using much less water per horse-power than any engine yet made; but it does not follow that such an engine will be the most economical, as that will depend upon the interest charged for the use of money and the price of fuel, as it would cost more per horse-power to build such an engine than one working under ordinary conditions. With money at six per cent. per annum and the cost of fuel to evaporate one ton of water at one dollar, a certain plan would be advisable. Again, with the money at three per cent. per annum and the cost of fuel to evaporate one ton of water at 50 cents, the same plan would be good, but as the cost of money and the cost of evaporating water change relatively, the best plan for economy in a steam engine would necessarily change to obtain the most economical result in the use of money. The cost of room for the plant and the cost of water for condensation, together with other contingencies, must be considered in any plan for a steam engine that is to be adapted to the surrounding circumstances under which it may be required to work.

The cultivated human eye and ear are wonderful natural indicators to determine the working of many parts of a steam engine. By watching any moving part of the engine and listening to the sound of the steam in the steam pipe, a good idea can be formed of the point of cut-off. By a closer attention to the peculiar sound of the rushing steam, the efficiency of the cut-off can be partly determined. By listening to the sound of the exhaust and watching the crank-pin, a good idea can be formed of the lead; then by a closer attention to the peculiar sound of the exhaust, such as the time during which it can be heard, a fair idea can be formed of the exhaust line as it will appear upon the indicator card in this case. By a close attention to the motion of the reciprocating parts of the engine in crossing the center, the effective lead on the steam valve can be ascertained, particularly if the engine is not set to cushion largely on the exhaust.

The human touch will reveal relative motion in contiguous parts of machinery that is beyond detection by the eye or ear; as, by placing a finger on two pieces that are apparently firmly in contact, a motion will sometimes be felt that is not visible.

By cultivating the eye and ear and human touch, to help in judging machinery, every engineer will be filled with a reverence for the marvelous powers of the human machine of which he is master.

Some blind persons can, by the sense of touch in their tongue, guide a thread into the eye of a needle. Some watchmakers can ascertain if a watch is running accurately, within reasonable limits, by holding the watch to their ear and at the same time watching the vibration of the pendulum of a standard clock. The carefully trained pilot in a fog or dark night will depend upon his hearing to tell him when he is approaching an invisible object of any considerable size which projects above the water, as he will instantly notice a change of echo of the noise made by his vessel. Some engineers, trained to the sound of their engine, will notice a very slight difference in the working of any part by the change of sound, even when they are engaged in other work and apparently not listening to any noise.

To speak upon the steam engine, generally, is to endeavor to embrace a subject that has almost infinite aspects, and embodying innumerable plans of different men with fertile imaginations and ingenuity. The speaker has only endeavored to present a few views of the case in a short statement. The subject is too vast for complete treatment, and the life of an ingenious inventor can be occupied with efforts to improve only one part of a steam engine, and at the end find a vast space is left for further improvement.

The use of words to describe machinery, without the aid of drawings, must at present be unsatisfactory, as all of these words have meanings attached to them formed during a former civilization in which but little machinery was used, and the special sense in which they are necessarily employed in this statement must be understood before the intended meaning can be apprehended. A knowledge of the ancient and modern languages will afford no certain assistance in determining the meaning of words as used by mechanics in the absence of knowledge of the special meanings attached by them in describing details or mechanical operations. The dictionary depends mainly upon the leading authors for the meaning of these words, and probably they only knew them as associated with ideas entirely outside of all engineering or mechanical connections. When, in the progress of improvements, a complete dictionary is established, giving the meaning attached to words as applied by mechanics or engineers in describing machinery, it will then be easier to describe, by the use of words alone, any mechanical operation so as to be more readily understood. At present it is like taking a cold chisel to do the duty of a screw-wrench in many cases, when employing words to describe machinery. In the decisions in the patent cases before the Court, it has been wisely held that every patent is to be construed as meaning what is to be gathered from taking the drawings and words together, or, in other words, each patent furnishes its own dictionary. And it is reasonable to assume that the words the speaker has used, in an effort to describe some parts of the steam engine, will be taken to mean differently, to some extent, by different engineers or mechanics.

It is with some regret that the speaker is obliged to consider what he has stated as necessarily unsatisfactory, the pressure of professional engagements having prevented a careful preparation. A conference like this is well adapted to bring out facts, when, by the exchanging of views on various

points, a much better understanding of the opinions of members can be secured for the benefit of themselves and all other interested parties.

On motion of Mr. Francisco, the meeting adjourned, to meet at 9.30 A. M., February 13th, at Coates' Opera House.

THIRD DAY'S PROCEEDINGS.

MORNING SESSION.

Having moved back to the Coates' Opera House, after its one day's session at Music Hall, the Convention was called to order at 9.30 o'clock, A. M., President Weeks in the Chair, Secretary and Treasurer Garratt at the Secretary's desk.

Before proceeding to business, President Weeks announced that the badge of the organization entitled members to free passage on the lines of the Inter-State Rapid Transit Company and the Metropolitan Street Railway Company. Having disposed of this preliminary matter, the Convention took up the programme of the day's proceedings.

THE CHAIR: At the time of our adjournment, yesterday, we were discussing the steam engine. The paper of Mr. George H. Babcock, of New York, which will be presented by Mr. George E. Palmer, of Chicago; relates to a kindred topic and will now be submitted to the Convention.

Mr. Babcock's paper, on the Economical Generation of Steam for Light Stations, was read by Mr. Palmer, as follows:

ECONOMICAL GENERATION OF STEAM FOR ELECTRIC LIGHT STATIONS.

BY GEORGE H. BABCOCK.

In the early days of the introduction of water tube boilers, we were frequently met with the remark: "Oh, they may do very well for woolen mills, but have you any in use in a cotton mill? How do I know they will answer for that purpose?" or: "Yes, they may be very economical in a sugar refinery, but when you come to driving engines and steam hammers, that is another thing; they won't do for that." Of course, the answer to such objections was that steam was steam, and that which made steam most economically for one purpose would do the same for any other purpose—the steam caring nothing whether it was used for refining sugar or driving engines, for making flour, cotton or woolen cloth, or rolling iron. But, notwithstanding the plausibility of this argument, it is not quite true, for the

work to which steam is to be put, and the circumstances under which it is to be used, do in a measure control the conditions under which economy in its generation is to be secured. For instance, the most economical steam generator for railway locomotion would be a wasteful and inefficient apparatus for ocean navigation; steamship boilers and furnaces could not be recommended for factory purposes, nor would the best of stationary boilers answer for a steam fire engine.

There was, therefore, good common sense in the choice of the subject upon which I was requested to address you. The equations which determine the highest economy in generating steam for electric lighting purposes are different from those which would solve the question of economy on a steamship, a locomotive, a fire engine, or even for an iron works or a cotton mill, though many of the same quantities and much of the notation may be the same.

We need, therefore, first, in considering this subject, to ascertain the peculiar conditions which control the question of economy in electric light plants, and wherein they differ from those of other power stations. These conditions are:

First. The amount of steam required is not only quite variable, but is subject to unlooked for and sudden changes, which changes are in no way under the control of the management. In places like rolling mills, sugar refineries and dye works, where sudden changes in demand are frequently met, these variations are quite under control, and may be frequently delayed or avoided to favor the boiler house, but in electric lighting they can only be met by either supplying, or failing to supply the demand. The steam plant must, therefore, be one which will permit of quickly changing the supply to meet the varying requirements.

Second. The maximum demand is for a short period in each day, at the best. A curve plotted to show the output of electricity in a station having a good patronage will show considerable variations day by day, but always a mountain peak at about the same hour. This is peculiar to electric lighting and has much to do with the question of economy.

Third. An electric light station must be always on hand ready for work. It cannot take a vacation at the pleasure of its proprietor, the whim of its operators, or even the attending of repairs. A breakdown not only stops its own work, but that of many others, and jeopardizes often great and grave interests. Providing a plant, therefore, with apparatus liable to break down or difficult to repair, no matter how cheap in first cost, or economical in the use of fuel, would be, in the homely language of the old adage, "saving at the tap and losing at the bung-hole."

In studying the question of economy in generating steam for electric light plants, it is quite necessary to take all these conditions into consideration, in order to arrive at a proper solution, and to that end we must consider their controlling effect upon certain other elements which are common to all steam plants.

For the production of steam we require fuel and furnaces, boilers and

brains—the last not the least by any means, when economy is the aim. Let us take those up in order, and enquire what effect the environment has upon their selection.

First. Fuel—This is a word which covers a multitude of substances, and locality has very much to do in determining the choice as to what fuel is best to use. For instance, in Bogota, rosewood is found economical; in some parts of California, peach stones are used, while in other places saw-dust, peat, wood, bagasse from sugar cane, spent tan bark, straw and numerous other substances, compete with coal on the score of economy. Of coals we have also a great variety, and great differences in price. Anthracite, for instance, varies in price from $16 per ton in some South American localities, to 10 cents per ton, the price which the electric light station in Scranton pays for the use of the mountain of fine coal at its back door. Of bituminous coals there are numerous qualities, some of them worth fully double others for steaming purposes—but frequently the local coal of poor quality is cheaper than better coal brought from a distance. It is, therefore, necessary to determine this question for each individual, bearing in mind always that the cheapest in price is not always the most economical, and leaving the local circumstances to decide.

Second. Furnace—The kind of fuel having been decided upon, the furnace needs to be adapted thereto. No one furnace is best for all fuels, and rarely for more than one. For anthracite, a plain furnace, with a grate fine enough to suit the size of the coal, and with the greatest possible air space, is excellent, and amply sufficient when intelligently fired. When, however, you attempt to burn bituminous coal in this same furnace, you get poor results and abundance of smoke. The same furnace, however, may not be suitable for two different bituminous coals, and it requires great experience to be able to determine just what furnace is best in each case. And just here one of the controlling conditions already referred to, of the peculiar environment of an electric light station, comes in to modify the selection. It is to the furnace we must look largely for the ability to meet the sudden fluctuations in demand for steam. After the fires have been sluggish for a time on a small demand, it becomes necessary to almost instantly freshen them up to vigorous action. Hand firing and natural draft do not easily meet this requirement, and here arises also the greatest difficulty in the employment of automatic stokers in electric lighting stations; they, as a rule, do not admit of sudden changes in the activity of the fires. There is much to be said in their favor for all places where the load is comparatively constant, and in electric lighting they will become a source of economy if they can be adapted to the sudden changes in demand and can be worked with the same economy when firing for largely variant rates of combustion. To meet the controlling conditions, some form of forced draft, regulated by the steam pressure, seems to be essential, so that the moment the pressure begins to fall, the fire may be quickened automatically to meet the requirements. This has been done by attaching a pressure diaphragm to the throttle of the blower engine.

"Smoke consumers," so called, are generally wasteful of fuel, but fre-

quently they are demanded to meet the requirements of local laws. It is well to understand that there is no such thing as "burning smoke," but furnaces can be made to produce a minimum quantity. In this, however, as remarked of furnaces in general, one coal is not any criterion for another. A furnace which will burn a given coal without smoke, will frequently be found to smoke badly when supplied by another coal. This whole question of smoke production is generally more a question of brains in the fireman than of construction of furnace.

Automatic apparatus for handling coal and ashes is generally a step in the way of economy in electric light stations, as in other steam plants. But this is also controlled somewhat by locality, as for instance when, as at the Edison station in Milan, they pay but 20 cents a day for firemen, the addition of a few extra ones for handling coal and ashes does not add greatly to the running expenses.

Third. The boiler is perhaps the one thing which requires the most careful consideration in deciding upon an electric light plant. When we consider that in constant running, a boiler, to speak figuratively, eats its head off every three or four months, it is plain that a reasonable additional cost for an economical boiler is a first-rate business investment. In other words, a boiler which would save 10 per cent. of the coal, would pay 30 to 40 per cent. on its cost, annually, and would be cheap at a round price as against another as a gift. But how may we know what boiler is most economical, when every boiler maker swears, with or without reason, that his is the one? Usually, in fact, the one with the least foundation makes the loudest claims, even going sometimes to the extent of bombastic challenges and offering bets, on the principle, probably, that that will enable him to rank among the better class. Preposterous claims are freely indulged in by the ignorant. I knew a case some years ago where a maker of a new boiler offered to guarantee under heavy forfeiture that he would evaporate 19¼ pounds of water to one pound of coal. And within two months I have seen a letter stating that a certain boiler, having no single element of economy, would double the work in the same time, and with the same coal, that another boiler, which is known to give 75 to 80 per cent. of the theoretical efficiency of the fuel, could do.

Unfortunately, buyers are not all scientists, and too frequently the biggest story, however preposterous and unsupported, if unblushingly made, is permitted to weight more than real merit. But, as I asked above, how are we to judge and decide this question? Here are some general rules:

(*a*) Set down all claims to the evaporation of over 12 pounds water per pound of combustible (unless it be oil, gas or hydrogen) under any conditions as made ignorantly or with an intention to deceive, and avoid such boilers as are claimed to do this, as either humbugs or soda water factories.

(*b*) See if the boiler has the elements which are necessary to economy, such as a rapid and thorough circulation of water, thin heating surfaces, a well distributed flow of the hot gases, of sufficient duration to secure thorough absorption of the heat, and ample disengaging surface to permit the steam to be drawn off free from entrained water.

In this matter of circulation of water a caution needs to be given, also, as against many unfounded ideas and claims. To secure an effective circulation of water, the currents must not only be separated from each other, but they must combine to form a continuous circuit (without interfering eddies or material enlargements), until the steam is ready to be separated from the water. Thus a series of horizontal or slightly inclined tubes, open only at one end, have many interfering currents and but a very slight circulation. Return bends connecting two or more inclined tubes cause such a collision of currents going in opposite directions as to effectually destroy the circulation, and when tubes open into an uptake wide enough to admit a downward current within it, the most efficient factor of circulation is taken away.

(*c*) Observe the record of the boiler for a term of years. Single tests may be made to show superior results with a boiler which is anything but desirable for actual use. Tests made in regular work are best, if disinterestedly made by competent engineers, but even here one needs to be on guard, as not infrequently tests purposely distorted are put forth as correct. A case in point: Near Manchester, Eng., a firm having put in a water tube boiler, employed a well-known engineer of a boiler insurance society to test it. He made out that it was evaporating only about six pounds water per pound of coal—less than the ordinary Lancashire boilers. Suspecting that the test was colored by the well-known antipathy of all boiler insurance companies to any boiler claiming to be safe, on the ground that people may, therefore, not desire to have it insured, Prof. Kennedy, of London, the best known expert in the kingdom, was employed to make a test of the same boiler, and though it was, as he states, handicapped by the working conditions, he obtained under actual conditions of practice ten pounds evaporation per pound of coal.

But it is not necessary to enlarge further on this point, it being admitted that in wisely choosing a boiler, the heaviest claims for economy are not necessarily to have the most weight. There is here, as elsewhere in the problem, ample room for a coefficient employed by the late Hamilton E. Towle. At one time he read a paper before the Institution of Civil Engineers, in England, and in all his calculations as placed upon the blackboard there appeared a peculiar and unexplained quantitative character. When he was through, one of the members rose to inquire the meaning of that mathematical sign, which was quite new to them. "That, gentlemen," answered Mr. Towle, "represents the coefficient of common sense, which we find necessary to employ in all such calculations."

But in considering the choice of a boiler for electric lighting purposes, economy of evaporation is not the only necessary element. There are three others of as great importance, if not greater. One of these is the ability to be forced for a short time while the maximum load is on. This is very important, otherwise it is necessary to put in a plant large enough for the maximum and run it at great disadvantage except for the two or three hours a day when the demand is at the greatest. But if the boiler, while adapted to the economical generation of the average amount of steam required, can be

forced readily to meet the greatest demand, even if it should be at a reduced economy for the time being, the average economy will be better and the interest account will also be less.

Another point of importance is safety from explosions. An electric light plant, as a rule, must be erected in the center of thickly populated communities, and, therefore, it is more important, possibly, to secure safety from explosions in them than in most other steam plants. Now, while a common boiler may not be liable to explode under good care, yet one of the most difficult things to secure under all conditions is this good care. Even the best of men become careless or forgetful at times, and hence good boilers sometimes explode when least expected. It is far better economy, even at a greater cost, to put in a boiler safe from destructive explosions, than to run the risk of a blow-up, with loss of time and capital, not to mention human life. Instance the Edison Company, at Chester, Pa., where the explosion of a new and well made return tubular boiler killed seven and wounded eight persons, besides demolishing the building. Even at a much higher first cost, a safe boiler would have been good economy. But it is necessary in this matter also to employ a coefficient of common sense, because so many claim safety for their constructions when they violate every element of security from explosion. As a rule, a water tube boiler properly constructed should be a safety boiler, but the mere presence of water tubes may be no surety whatever. For instance, a boiler with a large shell bored full of holes like perforated card-board and strained almost to bursting by reason of water tubes being expanded into these holes—an exceedingly unsafe construction—is advertised as "Safety Boiler." Perhaps, if the law in this country made the boiler maker criminally responsible for accidents in such cases, as it does in France, there would be fewer such reckless statements. In applying the coefficient of common sense to this problem of safety, one needs to remember that a large shell exposed to the direct action of the fire and all flat surfaces, stayed or unstayed, are elements of danger, and that this danger is greatly augmented by insufficient circulation of water whereby unequal expansions are permitted to occur, with consequent straining of the metal.

The third important question to consider in selecting a boiler for economy is its liability to repairs. A boiler which is under frequent repairs is dear at any price, and one in which repairs are not quickly and cheaply made, is in the same category. This point is best determined by a long and extensive experience. Nothing else can decide it with any certainty. While tubular boilers may last for years in favorable circumstances, their *average* life is usually stated to be not over 10 or 12 years, and their average repairs are usually estimated at 10 per cent. per annum on their cost.

Many go years without repairs, and I do not vouch for this estimate, only giving it as one accepted in ordinary calculations. As for water tube boilers, the makers of the best known example publish the results of experience with an aggregate 100,000 horse-power which have run from 2 to 20 years, and on which the average repairs to the boiler proper had been but about one-half of one per cent. per annum. They claim, moreover, and it cannot be success-

fully disputed, that in over 20 years' experience not a single boiler of that kind has been worn out in use, and that of all which have ever been sold in 23 years not less than 98 per cent. are in use to-day. It is unfortunate, however, that the same cannot be said of water tube boilers in general.

Last, but not least, we come to the element of brains. No matter how good or cheap the fuel, how perfect the furnace, or how exceptional the boiler, unless brains are placed in charge, the preparation goes for naught. It is not difficult to find a difference of 25 and even more per cent. in economy between the extremes of firemen with the same plant, to say nothing of repairs and stoppages caused by a little carelessness. It pays to have men of brains as well as brawn and muscle, even for firing fuel and watching water.

We have thus hastily considered the necessary conditions of economy in generating steam for electric lighting plants. Let us review them as a whole.

First. The use of the fuel which gives the best results for the least money. This varies with the locality.

Second. A furnace which will burn the said fuel to the best advantage, and at the same time permit of the rate of combustion to be quickly changed to meet the greatly varying demands without serious loss of economy between the highest and the lowest.

Third. A boiler which will utilize the heat to best advantage; which will give dry steam; which will permit of being forced much above its average rating for short times, without serious loss of economy; which is safe against destructive explosions, and which is not liable to frequent, difficult or costly repairs.

Fourth. Foreman and firemen with brains enough to employ all these things to the best advantage, and keep the apparatus at a point of maximum efficiency.

In selecting these elements of an economical plant it is urged that the coefficient of common sense should be fully employed, and that facts gained from long experience are a far safer reliance than mere assertions not backed by years of practical results.

APPENDIX.

The following items, having more or less reference to the subject matter of this paper, will, I think, be found of interest by the members of the Association.

IMPERIAL CONTINENTAL GAS ASSOCIATION, VIENNA.

This plant, which has been at work since August, 1887, is very complete and efficient. Its principal work is lighting the Opera House and Hofburg Theatre, which contains the equivalent of nearly 15,000 incandescent lamps of 16 candle-power each. At the station there are eight Babcock & Wilcox water tube boilers, each having a heating surface of 131 square metres, which are fired entirely with coke, and supplied with water from the Danube Canals which, however, is filtered and chemically purified before being fed into the boilers. Four Worthington pumps are so arranged that the water

may be pumped direct into the boilers or first through an exhaust steam heater, all connections being in duplicate. The engines are Willan's direct-acting high-speed, three of 170 indicated horse-power each, and five of about 130 horse-power each, and four smaller ones. These engines run from 400 to 700 revolutions each, according to size. The engines are coupled direct to dynamos of the vertical double magnet type made by Crompton & Co., the three larger ones giving 250 amperes at 400 volts, and the five smaller ones, 130 amperes at 450 volts. The small engines running at 700 revolutions per minute give 150 amperes each at 50 volts, and are only used for exciting the magnets of the larger machine. The engine room is fitted with an eight-ton overhead traveler to facilitate repairs, etc. In the central station is also a workshop supplied with lathes, winding head and other tools necessary for effecting all repairs, as also a laboratory, photometer room and the necessary offices of the building. In the cellars of each of the buildings lighted are placed large batteries of accumulators having 100 tons of plates in each, which are charged during the day from the central station. At night and during the performance the current from both the machines and the accumulators is used, the latter serving both for storage and regulating purposes. An elaborate test of this plant was made by Inspector Ehrendorfer and T. W. Mehlnish, A. M. I. C. E., a graphic representation of some of the results of which is hereafter given. The following is a summary of economical results obtained, the coke and the chimney gases having been carefully analyzed to determine the available heat in the coke and the amount carried off in the chimney.

The theoretical evaporation, with one pound of coke, of water from 32° to steam 212°, in pounds	11.½.	
Of which there are used for generation of steam	79.21	per cent.
There was lost in the chimney gases	15.47	" "
Waste of coke in ash pits	.88	" "
By conduction and radiation	4.44	" "
Total	100	per cent.

77.59 per cent. of the indicated horse-power was delivered in electrical horse-power. The consumption of feed water per electric horse-power per hour was 38.05 pounds. The consumption of coke per electric horse-power per hour, 3.78 pounds.

The largest proposed electric lighting plant in the world is that of the London Electric Supply Corporation, at Deptford. The buildings now erected are intended to contain, when finished, 80,000 horse-power of boilers with the corresponding engines and dynamos. At the present time there are erected 24 Babcock & Wilcox boilers of 250 horse-power each, two compound Corliss engines of 1,500 horse-power each. There are now being erected four engines of similar design of 10,000 horse-power each; that is to say, these engines are double, one-half of which are at first to be erected, to work at 5,000 horse-power; afterward, a second engine to be coupled to the same shaft, making them full 10,000 horse-power each.* Each engine is to drive

directly a single dynamo, sufficiently large to employ its entire power. The smaller engines, 1,500 horse-power each, are to give off 1,250 electric horse-power, after deducting loss in mains, switches, flues, etc., and the 10,000 horse-power engines with their single dynamo are to give off 10,000 electric horse-power each. The exhaust from the engines will be connected into one main, with separate condensers worked by independent engines. The dynamos are constructed for the alternating current. The exciters are driven by triple expansion engines running at 280 revolutions. The feed water for the boilers is taken from the hot well and pumped through economizers, of which there is one in connection with each battery of six boilers. Steam pipes are of copper throughout; feed pipes partly wrought iron and partly of copper. The pressure of steam carried, 200 pounds to the square inch; all exhaust, not only from the main engines but from the feed pumps and blower engines, is carried into the condensers. The plans for this station contemplate its enlargement at a future day, when it is expected to contain 120,000 horse-power of boilers and engines. It is to be worked on what is known as the Ferranti system, with 10,000 voltage.

The same company has another station at the Grosvenor Gallery, which has been running for some years. It contains four Babcock & Wilcox boilers of 164 horse-power each, carrying 140 pounds pressure, which are worked continuously day and night to upward of 1,000 horse-power. The engine room contains one Corliss engine of Hargreaves' make, four foot diameter of cylinder, running at a piston speed of 780 feet and coupled by ropes to a Ferranti dynamo, with a capacity of 15,000 eight candle-power lamps. Three other horizontal high pressure engines, with ordinary slide valve expansion cut-off gear, are connected to a counter-shaft from which another dynamo of smaller capacity is driven. Another engine and dynamo is kept in reserve for lighting the Grosvenor Gallery or to act as an exciter to either of the above dynamos. The exciters of the large dynamos are attached to an armature shaft and form really part of the machine itself.

The next most important electric lighting company in London, is the Metropolitan Electric Supply Corporation, Limited, which has at present four stations, of two of which data are given: *Sardinia Street Station.*—This contains four Westinghouse engines of 250 horse-power each, driving by belts alternate current dynamos, and two smaller Westinghouse engines of 50 horse-power, driving exciters by means of belts. There are five Babcock & Wilcox boilers of 250 horse-power each, carrying 150 pounds pressure per square inch. *Rathbone Place Station.*—Five boilers of 160 horse-power each, carrying 200 pounds pressure per square inch, and six Willan's triple expansion engines, coupled directly to Elwell-Parker dynamos, giving 1,000 volts and 100 amperes, at a speed of 355 revolutions per minute; number of alternations, 12,000 at this speed. Two smaller similar engines are coupled direct to continuous current Elwell-Parker dynamos, giving 150 volts and 180 amperes—used for exciters. All the connections, both steam and water, are made on the multiple arc principle.

The Kensington & Knightsbridge Electric Light Company have two sta-

tions, one at High Street, Kensington, and the other at Chapel Place, Knightsbridge. In the former are two Babcock & Wilcox boilers, giving 500 horse-power, indicated, and two high-pressure compound Willan's engines directly coupled to Crompton dynamos. This station is soon to be increased to about 2,000 indicated horse-power. In the Knightsbridge Station there are two Babcock & Wilcox boilers, giving 700 indicated horse-power, the engines and dynamos being substantially the same, which is also to be increased to about 1,900 indicated horse-power. In the two stations there are, therefore, after making allowance for spares, about 1,900 kilo-watts available, or the equal of 57,000 ten candle-power lamps lighted simultaneously. As, in the Crompton system, accumulators are employed as a means of distribution and reserve, these stations will be equal to the supply of 75,000 lamps burning simultaneously, and according to London practice, 150,000 lamps can be rented out.

The cost of producing a unit has steadily decreased in this station until it is claimed that the cost for fuel, oil, water and all wages and material used for working the station and other general repairs, being divided out to the number of units sold to consumers during the month, amount to only 1⅛*d.* (2¼) per Metropolitan unit. Crompton & Co. would be very much interested to know whether in America, or any other country where the work is being carried out on an equal scale, any economic efficiency approaching this has been obtained.

THE PRESIDENT: You have these papers, of Mr. Woodbury on "Central Station Construction," and the "Steam Engine," by Mr. Sickles, before you. Mr. Sickles will say a few words in opening the discussion on these subjects.

MR. SICKLES: Mr. President and gentlemen: I do not know that I shall discuss my own paper, but I will discuss the paper on boilers. I would say, in regard to Mr. Babcock's paper on boilers, which has just been read, that I agree with it in the main; but I object to one statement, which I think it is right I should mention, and that is the statement that stayed services are unsafe. Now, this is a question of fact. We have tried boilers long enough to know whether stayed are unsafe; and we have in the world thousands of locomotives running into stations every minute with a large amount of stayed service in them for 50 years and not one of all these have ever failed. It is not true that stayed services are unsafe. They may be made unsafe, but they are not necessarily unsafe; and, therefore, I shall have to object to that part of the statement. But the general scope of the statement, I think, I can agree with. The idea that you must put a very rapid current through a tube and subject it to the passage of the heated gases at right angles to

this tube is correct. All experience shows that the best results have been obtained by placing the tube in that position where the current will pass rapidly through it and the heated gases impinging against it at right angles, as a matter of evaporation. But, of course, common sense, when we come to reflect, will tell us some things. This tube must be made so as to carry high steam, and be reasonably small, so that we can get a large amount of surface in a small space. And it only comes then to the question of what is the best way to get that general result. I do not think it would be proper for me to mention any particular form of boiler that would be likely to come into use in an electrical plant, which illustrates, however, the value of very rapid circulation, with the gases impinging upon it at right angles, and that is the Herischoff boiler. That is an apparatus of enormous ability for the surface and gets a very wonderful result, of course, at disadvantages that would be utterly impracticable in an electric light plant.

I believe, so far as being able to force a boiler is concerned, I think his statements are correct. It is important to so arrange the boiler that it can be forced in an emergency, and not be obliged to carry a large number of boilers that would be available, perhaps, only an hour in 24. It is better to sacrifice a little economy rather than have too large an amount of money lying idle, as would be the case in having too large an amount of boiler surface. That is about all I have to say on this subject. (Applause.)

Mr. T. C. Smith (of Philadelphia). Mr. President and gentlemen; I think that the question of boiler surface in a station is one of the most important we have to deal with; and I think that there are two or three points about central station work that should be taken into consideration in discussing the form of boilers to be used.

With regard to the question of being able to force your boilers, that proposition has another side to it, beyond that of the mere question of having money lying idle. There are very few central stations doing incandescent work, but in which the bulk of the load does not come within two or three hours in the day, and the load at that time will be enormously in excess of the average load. If you can force your boilers during these two or three

hours, by keeping the fires clean, and being ready for the heavy load when it comes, you not only save the cost of a surplus boiler plant, but you save very largely in your fuel consumption I know of a station where the fuel consumption is increased 50 per cent. by the necessity of having to fire up the second boiler for the two or three heavy hours' duty between four and eight o'clock. The banking of your fires during the day must be done, or you have either to make a fresh fire. In order to carry a banked fire, a banked fire takes as much coal, a good deal more coal than would be sufficient to run that heavy load, if you are able to force your boiler a little more, and burn that coal under the boiler that was being forced. For that reason I think that a large source of economy will be found in central stations by putting in a forced draft apparatus, more than in increasing the boiler capacity. I know there is strong prejudice against forcing boilers, on the score of danger from it, but I do not think that any electric light station should be run by any man that cannot be trusted to force a boiler without endangering it. I do not mean to force a boiler, of course, beyond a reasonable degree. With regard to the remarks on flat stayed surface, I have only one thing to say. I was brought up on the big shell boiler, boilers running anywhere from six to seven feet in diameter, and one or two big flues through them; and there are several points in favor of that boiler that ought not to be overlooked, such as the easy cleaning and examination. Now, it seems to me that when we once leave that large shell and come down to the use of tubes, that we might as well throw out the whole thing and get rid of every objectionable feature in a boiler that we can. Now, it is true that flat stayed surfaces have been used for many years. It is true that the bulk of the locomotives in the world are using flat stayed surfaces in their firebox; but I think that ever since the flat stayed surface was put on locomotive boilers, there has been a constant desire to get rid of it if possible. It can be made safe, but it is always liable to deterioration and to get in an unsafe condition. I do not know anything that is easier to get in a bad condition than a flat stayed surface. Therefore, I think if we can get rid of the flat stayed surface, it ought to be done. If there should be two boilers, one of them which has the flat stayed surface and the other of substantially the same con-

struction and principle, which is without it, I would always use the boiler without the flat stayed surface. (Applause.)

MR. SICKLES: I will say, in regard to the flat stayed surface, that one element of safety in it is this, that the flat stayed surface, where you are carrying a regular pressure of steam, it yields very gradually, and it will give you notice weeks ahead that it is going to give out. You will frequently see flat stayed surface bearing indications for months before that it will give out. Hence, there is a certain measure of security in the flat stayed surface in that respect. It yields slightly; you can see the boilers running with a flat stayed surface, with a notice, you might say, painted upon them. They will still run for a while, but, of course, there will come a time when it will give out. But the practical fact is, there are hundreds and thousands of locomotives running into railway stations all over the world, that have been working for half a century, that have not given out, in the flat stayed surface; and that fact is to be taken against any number of opinions on the subject. I hold that a mechanical fact so strong as that cannot be answered by the belief of any number of persons.

MR. T. C. SMITH: I would like to ask Mr. Sickles if he has any figures showing the cost of keeping up these flat stayed surfaces in locomotives? I have been employed for a short time in locomotive shops, and I know that engines never come in off the road but that the flat stayed surface had to be tinkered with.

MR. SICKLES: I can say that every part of the locomotive boiler deteriorates very rapidly, and the gentleman will find, if he will look over his memoranda, that he tinkered as much with the tube as he has done with the flat stayed surface; that every part of a locomotive boiler gets out of order; it is a sort of a cupola on wheels. (Applause.)

MR. J. C. FIELD (of Brooklyn, N. Y.): Mr. President, I do not think we ought to pass over Mr. Woodbury's paper, submitted yesterday, without looking at it a little more carefully. We all know what Mr. Woodbury has done in New England mill construction. New England mill construction, in the last few years, has done more to bring up the standard of buildings of that class and make them safer against fire, than any other class of construction in the country. And when we see that these prin-

ciples there can be applied to small station construction, I think these points are such as the electric light companies ought to know and give attention to. When we can go into small towns and stations with hollow walls overhead, and all those things that go to make bad construction, and at very little expense, make them as safe as fireproof buildings almost, as far as fire is concerned, I think it is a matter for us to consider and profitably carry out.

MR. M. D. LAW (of Philadelphia): In the management of electric light stations there is one point that has not been specified by Mr. Woodbury, which is very important as regards safety against fire. I have discovered the same trouble in Kansas City in the plants that are located here, especially in some of the private installations, and that is the packing of waste underneath the machine for the absorption of oil. It, perhaps, looks to you like a little matter, but in nearly every case, especially where high tension currents are employed, you have to use a wooden floor for the measure of safety. By packing waste under the machine you place a tinder box there. It may run for years without any trouble whatever, but in the case of an armature's burning out, and armatures will burn out and throw fire for a long distance, this ignites at once, and you have a nice little fire to take care of. I speak of this because I had the same trouble several years ago in packing waste under a machine, an armature burning out and dropping some melted copper on the waste. The consequence was that all four field magnets had to be rewound on the outside and we came very near having a nice fire in our station. It was only having water buckets in close proximity to the machine and rubber blankets that saved us. The rubber blankets, I think, did more towards putting out that fire than the water buckets. They were immediately grabbed up and thrown over the fire and smothered it. I saw that Mr. Woodbury had not spoken of that matter, and it is an extremely important one. Mr. Woodbury has given us an explanation of a baby station. It is of hardly sufficient size for even a country town. In our experience it is far better to build a two story station, having your dynamos on the upper floor, your roof trussed in order that there shall be no posts or wires projecting up from dynamos to it to interfere with the rapid moving of

machines from one portion of the room to another, or the changing of armatures; as the continuity of your lights is the criterion of your success, you want to have your machines in such shape that an armature can be rapidly changed, and also that if the machine flashes, that the dynamo man can get there quickly, and that that machine may not flash the second time. Flashes mean rebates, and they are very expensive things to have.

Mr. S. E. BARTON (of Boston): In reply to Mr. Law, I think the reason why Mr. Woodbury has not referred to waste and things of that sort is because he thought that was beyond the scope or intention of his paper. His purpose was to describe the method of the true construction of the station, and not the methods to be employed in the care of the station afterwards. The question as to the danger of waste is purely a question of care, and gross carelessness or negligence may occur in the most modern constructed station as well as in the poorest constructed one. I do not think that that thing was out of Mr. Woodbury's mind. In fact, it is the very subject that absorbs his whole time. It is his business to see to the proper care and cleanliness of the risks which the companies he is interested in insure. I do not think it was an omission on his part, but that he simply thought it was unnecessary to go into that part of the subject. I agree with Mr. Law that the cleanliness of the station is a very vital thing. In fact, I go farther, and say it is the most vital thing as affecting the fire risk of the generating station to-day. I believe that more than three-fourths of the fires that have occurred in stations have been due to carelessness, to want of cleanliness, and little bits of carelessness in the same line as those of which Mr. Law has spoken, from spontaneous combustion and other causes. I believe further that a thing that is very sadly overlooked and not thought of in the care of central stations is the conditions of oil, aside from the waste itself. The unnecessary amount of oil that is allowed to accumulate on the station floors about engines and dynamos, so that when once a fire occurs, from any cause whatever, the material of the most inflammable nature is there in order to spread the fire in a perfect flash from one end of the station to the other. The air and floor are filled with volatile inflammable substances from the oil. I believe it is just as easy to keep

the floor of a generating station as clean as a kitchen floor. It is just as easy to do that as it is to have it saturated and swimming with oil. I believe the floors should be made of hard wood and should be kept free from oil by washing at least once a week, and twice a week, if neccessary, and should be kept almost absolutely free from oil. We have any quantity of stations in that condition to-day, where you could scarcely soil a cambric handkerchief on the floor, except from the coal that is tracked in from the boiler room, but as far as oil is concerned, they are absolutely free, and there is no danger of fire in such stations. If a fire starts, it cannot make any headway. When a station is constructed as Mr. Woodbury designs, it is slow burning anyway. There is nothing for the fire to feed upon to gain rapid headway. The keeping of a station clean by washing the floors, in some instances, cannot be well and safely done with the present practice that prevails almost universally of running wires from dynamos down through the floor, for no purpose that I can conceive of, except for the purpose of bringing them up from the floor again. I know of no reason why wires cannot go direct from the dynamo overhead in plain sight.

MR. SICKLES: I will say, in regard to fire, the Cunard Line of Steamers ran for 30 years without having a fire, but they always had the hose stretched on the deck; that was the thing to do. The great thing to do is to have your hose ready for the fire, and if it is ready you will not have much of a fire. Fires break out and then people say that it all came at once. You see that in the paper every once in a while; that is not true. If in all the stations you will make proper preparations for fire and sustain them, and if the superintendent will strike the alarm once in a while, and see how quickly it is responded to, you will have no fire in the station. I was going to say the fire will not dare to be in.

MR. J. A. SEELY: I would like to ask for information in relation to the building of floors. I have not heard any opinion expressed in relation to concrete floors. I would like to know if there is any objection to concrete, and what has been the previous experience in that line?

M. J. FRANCISCO (of Rutland, Vt.): If the gentleman will build a concrete floor and put his dynamo on it, and then try to

handle the floor, he will get an illustration of what it is. In regard to Mr. Sickle's remarks about the hose, it is an old saying that "an ounce of prevention is worth a pound of cure." My idea is to put the station in such a condition that there will be no occasion for fire, and then you will not have to have any hose.

MR. TORREY: I am not a member of the Convention, but I would like to say a word.

THE PRESIDENT: You may proceed.

MR. TORREY: Almost everything that has been said on all these three papers came from men who are in charge of large plants, or owners of large plants, in cities where if a good plant is not set up in the present light of mechanical engineering, there is some fault somewhere. I have spent most of my time for the last five years among the plants of our country brethren where they do not have the facilities that you have in the cities, and the problem there I claim is a totally different one. I have never heard in any electric light association, or seen in any literature on the subject, anything that would throw any light on the construction of stations in the country. Of course, a little station of 25 lights is a small thing, but it is going to grow, and a great deal of the support of electric lighting is going to come from the country. The boiler question is an absolutely different question where you have a city with a good soft water supply that comes in hydrants, and where you can have the water brought into the building, from where it is in places where the year round there is nothing to depend upon but an intermittent supply of water that is hardly fit for use in boilers anyway. I saw a station the other day of about the size that has been spoken of before, where the load runs up to perhaps 500 incandescents during one part of the evening, and along after 12 o'clock the engine wags along with a maximum load, according to the indicator, of about 27⅜ horse-power, of which $18\frac{5}{10}$ horse-power is friction load, and then in the early part of the evening, when the whole load is on, the load piles up to as high as 80 or 90 horse-power. Where is the economy in that? It is unnecessary to say to any man who knows anything about electric lighting, that the station has never paid a cent, and it is still more obvious that it never will pay a cent under those circumstances. I remember another station that I visited last

Summer, where I was requested to overhaul the engine. It was one of the very best engines, and the only trouble with it was that when it got out of order, they gave the job of repairing to any tramp that came along, and after about three tramps came along the engine was in such a condition that no mechanical engineer in creation, unless he took a whole machine shop with him, could put it in good condition. I tried for three days to set the valves and it ran well for about an hour, and when I came back the next day, it was just in as bad a condition as ever. No man in creation could put it in good order and make it stay. The mechanical part of electrical construction is substantially all of it. I will venture the assertion, and I can back it up by any amount of figures from my experience, that the majority of country stations do not pay, and the reason is because of the fault in mechanical engineers.

THE PRESIDENT: Is there any further discussion on this subject? If not, with instructions to the Secretary to spread upon the Minutes of the Association these papers and all the discussion thereon, we will consider the topic passed.

We will now hear a paper from Mr. C. J. Field, of Brooklyn, on the Development of Generating Stations for Incandescent Light and Power.

Mr. C. J. Field, of Brooklyn, then read the following paper:

DEVELOPMENT OF GENERATING STATIONS FOR INCANDESCENT LIGHT AND POWER.

BY MR. C. J. FIELD, OF BROOKLYN, N. Y.

I desire to present to you a brief review of the present and prospective future of central power plants in the larger cities, taking as an illustration one of the more recent types, describing its general arrangement, then proceeding to the consideration of its initial cost, earning capacity, output, operating expenses and economy, and, in conclusion, trying to indicate the immediate future development in this class of work.

CENTRAL STATIONS.

The immediate points to be considered and carefully weighed in the designing of central power plants for a large city are many, and they should receive careful survey before any work is proceeded with. We will briefly summarize them, as follows:

First. Recognition of the importance of safety and reliability in operation.

Second. Obtaining the true economy of output under all conditions.

Third. Installing of plant in a building entirely suited to the working

of same, and, as far as human ingenuity can provide, proof against destruction.

Fourth. Adaptability to proper and economical working of the plant.

Fifth. Division of the generating power into the proper number of units for the safe and reliable operation of the plant.

Sixth. Flexibility of system, that is, adaptation to furnishing current for light, power and other sources of revenue, the obtaining of the largest return per dollar invested, and not carrying to excess for the mere sake of engineering by any part of the plant for the obtaining of proper results therefrom.

Seventh. Not installing the plant for mushroom growth, but laying it out for comprehensive business, thereby securing, at as early a date as possible, the entire confidence of the invested capital.

A true and careful consideration of these points will prevent trouble later on. Much of the trouble of stations at the present time, in their standing with the community, is due to neglect of this point, and the majority of their failures as well. We have got to recognize the fact that the public, to a certain extent, have become prejudiced in a measure, somewhat unjustly, but this is all the more reason for better and more conservative management, and giving them good construction. No more inviting field is offered for either investing capital or good engineering than central stations for lighting, power and railway work.

A REPRESENTATIVE STATION.

I propose to take as a representative type, showing the present development and first-class work, the station of the Edison Electric Illuminating Company, of Brooklyn, which was completed last Fall and is now in successful operation. With the aid of illustrations, which are included here, I will give a general outline of the arrangement of this plant and apparatus used.

In the arrangement of this plant there was somewhat of a departure from previous general practice in this line, the company trying to secure the benefit of past experience in the larger stations of this class, both in the arrangement and kind of apparatus used, trying to secure, at as economical a cost as possible, the best plant for the purpose. As will be seen by the longitudinal section through the building, the general arrangement is as follows;

The boilers and engines are located on the first floor, the engines being on the front half and the boilers at the rear, thereby bringing everything on this part directly under the eye of the chief engineer, making it much better than where the boilers are located two or three stories up; this was obtained by spreading out a little more on the ground. The boilers are Babcock & Wilcox's largest type of sectional water tube boilers. The engines are 300 horse-power, compound, horizontal, automatic engines, manufactured by the Ball Engine Company. Each engine is directly belted to two generators. The plan of the engine and boiler room floor will also show in more detail the general arrangement here used, and, I think, needs no further explanation.

Ascending to the second floor, we reach the electrical part of the plant.

Here are located in the front part of the building, directly over the engine room, 24 dynamos, each with a capacity of 750 amperes and 140 volts. Each dynamo weighs about eight tons. Overhead traveling cranes are installed here and in the engine room for ready and quick handling of all apparatus. Through the center of the dynamo room is located the electrical gallery. From here are controlled the workings of all the dynamos and other apparatus, also all outside lines. Everything in connection with handling, generation and furnishing of current, is directly under the eye of one man in this gallery, and from which he has a general view of the dynamo room floor and the workings of the dynamo, a second man being on the floor to see to the bearings and brushes. From this gallery run all the feeders, which connect into the net-work of mains, covering over an area of about one and one-half miles square. The ampere meters are located on each feeder, so as to show the load in each part of the district. This plant maintains its distribution and regulation thereof by balancing within itself. No feeder equalizers are here used for feeder regulation; the uniting and tying up of the system together with the use of the auxiliary bus affects this regulation. All circuits of this plant are underground, there being about 25 miles of underground conductors. These have given perfect satisfaction and reliability in their workings, maintaining to-day an insulation on the system as a whole of over half a megohm.

On the rear of the second floor are located the coal storage, water tanks and feed water heater. On the top floor we have the offices, supply rooms and workshops of the company. Returning down stairs again, we find in the basement ash pits, smoke flues, pump room, two large coal storage vaults, giving a total capacity for storage of over 1,000 tons, air blast for force draft, and other details in connection with the steam plant.

We have, therefore, here in a building 75x100 feet, apparatus and all departments complete for the generation and supply of current and power for a capacity of 40,000 lights, or the equivalent in light and power; and so arranged as to secure, as far as can be foreseen, continuous working of the plant and entire reliability in the furnishing of its current. It is only thus that we can hope to obtain a business and establish ourselves on the commercial basis which gas light companies have placed themselves in the past years, and thereby secure to our stockholders the returns for which they have invested their capital.

Having thus generally outlined this plant, we will now turn our attention to the consideration of other points in connection with it. One of the most important items is the cost of such a plant. I give you below, in round figures, the cost as shown by the construction accounts and estimates:

Station building, complete, including all fittings, foundations, stacks, furniture, etc.	$100,000
Real estate	36,000
Steam plant, including engines, boilers, pumps, heaters, piping, bells, etc.	50,000
Electrical plant, including dynamos and all electrical apparatus, as switches, etc.	40,000
Underground system material	115,000

Excavation and labor installing same.....	$35,000
General, including lamps, meters, tools, instruments, engineering and architectural expenses, wiring, services and office furniture.	50,000
Total..	$426,000

This includes the entire cost for the plant as it stands to-day, which, as far as the building is concerned, is complete for the entire capacity. At present there is installed generating capacity of boilers, engines and dynamos, for one-third of the final output of the plant. The electrical apparatus is complete for the entire output, with a very few additions in the way of a few switches, etc. The underground lines have a capacity for 20,000 lights. The work necessary to complete the plant for its entire capacity would amount to about $200,000 additional.

For this amount there has been obtained here a plant which is considered equal, if not superior, to any of this class, and at a cost of 20 to 30 per cent. less than is expended for similar ones.

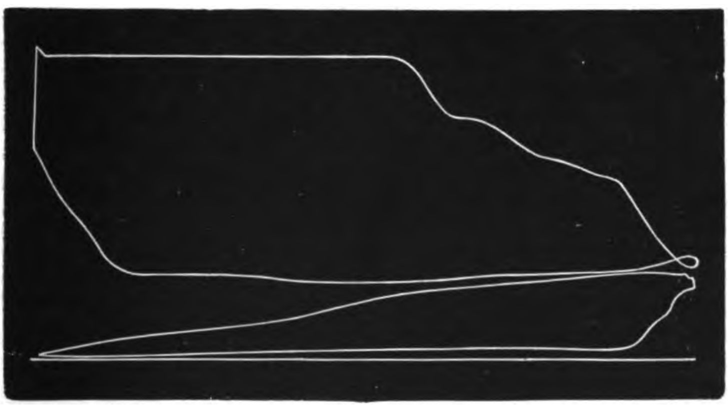
I will take up the next consideration of the operating expenses of such a plant. In order to place the company on an earning basis we have to secure, to start with, a certain number of lights or an equivalent in lights and power to clear the necessary general and operating expenses which will exist regardless of the smallness of the load; in other words, we must have for such a capacity plant not less than 5,000 lights with an average income of eight dollars per light per year to clear the general incidental and operating expenses. This figure we may consider as our unit of operating capacity. From this we can figure the increased earnings and profits for the larger number of lights connected. There exists practically a constant ratio of variable and fixed operating expenses. By variable expenses we mean those obtained on a variation in load and increase of business, this includes coal, oil, lamp renewals and small increase from time to time in the amount of labor employed. The fixed expenses include those items which remain practically constant under varying conditions of income. A careful analysis of all the items covered in these expenses in such a station as this one, gives the following result: That the fixed expenses are 75 per cent. of the whole, and the variable, 25 per cent., approximately, or, in language which may appeal more directly to you, if we double our income or business, we only increase our expenses 25 per cent. This shows that a station's possibilities and profit lie in increasing this business from the unit point.

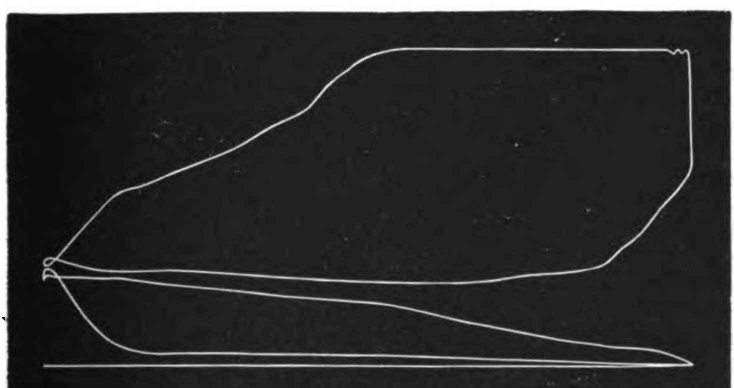
The average income per light in stations of this class varies in different parts of the country and with different loads.

We have illustrated a load diagram taken from this station, which gives you a fair idea of the changes and variations here taking place. The maximum number of lights lighted at any time in proportion to the number connected is very good for such work and shows a good class of business. The load diagram through the day, however, shows a new station on a clear day with a small number of lights lighted and power work only just commencing. It is this power work that wants attention and the securing of which means the bringing up of this average load during the day-time to a

good paying basis. The curve for the evening hour indicates a good, broad, solid load, which shows the combination of six o'clock business with the addition of a good solid evening load. Many stations after reaching the maximum point around six o'clock, rapidly fall off and never regain this point again for the evening. Here we have the illustration of clubs, theatres, churches, concerts and residences, lighting after supper, bringing up the load to its maximum point between eight and nine o'clock. The average load for the 24 hours, which is about 25 per cent. of the maximum, is a very fair one, and with the addition of the day load that will come on with the addition of power, will make this a model load diagram. The general run of stations shows as an average for the 24 hours, from 20 to 40 per cent. of the maximum load; the latter figure is very seldom reached. The writer knows of one station in which we have the latter figure and where, if we eliminate one short half hour around six o'clock, we have the remarkable showing of 75 per cent. average load for the 24 hours.

I also wish to illustrate here some remarkably fine indicator cards, which show the workings of the engines of the steam plant in this station.





The division of work shown on the cylinders is as follows:

I. H. P. head end high pressure cylinder			$63\frac{8}{10}$	H. P.
" crank end	"	"	$60\frac{2}{10}$	"
" " low	"	"	$59\frac{2}{10}$	"
" head end	"	"	$55\frac{2}{10}$	"
Making a total I. H. P.			$238\frac{4}{10}$	H. P.

with a boiler pressure of 110 pounds, revolutions 223 and load 1,200 amperes, which is the equivalent of 2,725 lamps, therefore giving for the indicated power furnished, 11½ lamps per horse-power. This is for power developed, making no allowance for friction of engine and dynamo. The friction of the engine is less than five per cent. of its normal capacity.

Having in the above given a general outline of this plant, its cost and operating expenses, I now wish to call your attention to the points in connection with the type of engines, boilers, dynamos, underground system, etc., to be adopted in a station of this class.

"CONCLUSIONS."

We will first consider the question of the engine. As already stated, in proposing the engine power of a station of this kind, we first have to consider the question of using either the Corliss or high speed engine. Regarding the use of Corliss engines in a plant of this kind, we are frank to state our objections. Excessive first cost, ponderous machinery, counter shafting, pulley, clutches, etc., lead us to believe that these things are unnecessary when the problem is carefully considered from an unbiased standpoint. What we are after is results, not theory, but actual practice. Assume, for the sake of argument, that we can save five or ten per cent. in steam economy, if this is obtained at a cost, the interest of which amounts to more than this, we are obtaining it for no good whatever; furthermore, there are many other problems in electric light stations which we have to carefully consider in this question of steam plant, one of which has been enumerated before, the question of reliability in operation and always being ready for service. One of the latest types of stations combining arc and incandescent, where we have the Corliss engine in all its perfection of detail and apparatus, is that of the Narragansett Company, in Providence. If one will carefully look over this plant, as I had the pleasure of doing a short time ago, with others, and consider all these problems carefully, and then examine a station similar to the Brooklyn one, I think he will be forced to admit this fact. We want to obtain our power as direct from the engine to the dynamo as possible, and at the same time as cheaply, and obtain the best economy under the variable loads that we are going to have. We cannot design our plant for that capacity which is reached, as shown on load diagram, for only a short time in the 24 hours, but we must so design it to give this result for the average that we have during the 24 hours. Even where we have a more constant load, as in exclusive arc lighting on municipal circuits, I think even here we need to carefully consider the problem as well.

High speed engines, so called, although they are not in piston speed any higher than the Corliss, but merely in rotative speed, have shown a considerable development and marked advance in the past year, and the next year is going to see even more development in this line. Owing to better workmanship, better designing and building than formerly, the prejudice which largely existed among old engineers against this type of engine, is rapidly wearing away. With the single cylinder engine under variable load, we often obtain poor economy, but, as compared with the Corliss, under similar conditions, allowing for the discrepancy in price, the result is not so disparaging. Now they are going further, and building compound and even triple expansion engines of this class. In the Brooklyn station we have one of the representative types of this class of engines, being horizontal, compound engines, which we here illustrate to show their general design in more detail. (See diagram.)

These engines are built for higher economy and economical work, and the guarantees made on them I think compare favorably with the guarantee on compound Corliss engines ; at least three or four of the manufacturers of this class of engine stand ready to-day to guarantee from 22 to 25 pounds of water per indicated horse-power per hour. I do not know of any Corliss manufacturers who are willing to do any better. This is for non-condensing, condensing from 17 to 18 pounds of water per horse-power per hour. Engines of this class are as well built now in workmanship and as reliable in operation as can possibly be desired. Added to this, we have the advantage of direct connection to our generators, avoiding all the intricacies of shafting, etc., and the unreliability they entail. Tests made at the Brooklyn station have shown that the engines have actually come up to the guarantee made on them, and that the plant there is showing, as compared with single cylinder engines, an economy of coal per unit of output from 25 to 30 per cent. better. In a station of this kind, the actual coal consumed per unit of output at the dynamos is considerably larger than is shown on a direct test where we charge the engine only with the coal it uses directly. The weekly records from stations of this class charge the horse-power output with all the coal used by the engine, pumps, condensers, well pumps, cleaning fires, blowing off boilers, etc., and where the former item is about three pounds of coal per horse-power per hour, we have in the latter case, making no allowance for the engine running empty, a result 50 per cent. greater than this. Economy in this line, however, is not going to stop at compound engines, as there are being built by at least two manufacturers, triple expansion high speed engines. I have not been able as yet to obtain drawings of this engine, but illustrate here a type of engines of this class, which has been imported from France by Mr. Thomas A. Edison. (See diagram.)

Something similar to this is what we may obtain to-day, if encouragement is offered, from such engine manufacturers as Armington & Sims, Ball Engine Company, McIntosh & Seymour and others. We are coming to a recognition of the fact that if we want the high economy, we can obtain it as cheaply and as well, not to say more cheaply and better, with an engine of this class as with engines similar to those installed in the Providence station. In guaran-

teed economy, it will equal the Corliss engine as installed in the Narragansett station, and give it to you under a wider range, the load.

In connection with the triple expansion engines mentioned, we have to consider, again, the problem of the dynamos to be used. We can stay as at present, and belt to our dynamos, but I believe that the next large incandescent stations will not only include compound or triple expansion engines of 300 or 400 horse-power, but will also have multi-polar dynamos, one or two being directly connected to the engine. By this I do not mean belted, but direct shaft connection through a flexible coupling. This, of course, necessitates the multi-polar machine, in order to secure the output with a slower speed. Engines and dynamos of this type can be installed in the space at present occupied by the engines alone. This means not only economy in building and real estate, but also in operating expenses.

In regard to boilers for such a plant, we do not know that we have any new economy to be hoped for in the near future. All we have to look for at present is improvement in detail of manufacture and the securing of better and dryer steam. We have two classes of boilers prominently before us for this work. We have, in general, first, horizontal tubular boilers, which we find in general factory use, to a large extent, throughout the country. Where we have plenty and cheap real estate, poorer attendance and moderate steam pressure, this class, in general, fills the bill. We find, however, that they are now even building them to work up as high as 125 pounds boiler pressure. When we come to construction of the boiler plant on expensive city property, where we are cramped for space, we are almost limited at once to some one of the types of sectional water tube boilers. In the Brooklyn station, we are practically limited to the consideration of this class, and we have not only 125 pounds, but 150 pounds boiler pressure, and even higher. We have also the advantage of quick steaming under heavy changes in load.

We have, to-day, brought before us in the underground systems, the consideration of what is to most of the companies their most serious problem, in the proper solution of which the best talent is being devoted. In the Edison underground system we have what is generally recognized as the most practical solution for circuits of less than 4 to 500 volts. We here obtain at a minimum of cost the most flexible system and local distribution from house to house, which has no equal. It enables you to take off services for local distribution from every 20 feet without in any way affecting the insulation on the main line, and being able at any time to disconnect these services and restore the main to its original condition. In any other system we have the problem of splicing and cutting of cables, which, at its best, is bad work. What we desire is not such a high insulation, as good, mechanical protection. As long as we can hold a moderate insulation with good mechanical protection, that is all we want. In Paris, they have used bare copper conductors, supported on porcelain in a concrete conduit. This has worked satisfactorily in the main so far, but, of course, is very expensive. They are now proposing for all their increase, the Edison tubing for this class of work. In any system of cables drawn in we have the selection

of a large class of conduits, but in my mind, all we need and desire, as I have before stated, is mechanical protection for these cables, and the cheapest conduit that will afford this protection is all that is necessary. What is wanted especially is some system of local distribution for these higher tension circuits. The underground system installed in Brooklyn has a net-work of underground conductors in the mains and feeders of over 25 miles. This entire system is so arranged, distributed and connected in a net-work that, with a drop or resistance of one per cent. on the mains and ten per cent. on the feeders, we are able to maintain in the system practically a perfect regulation in the distribution of the current. This system stands to-day representing one of the most complete and perfect examples of work of this class. The largest problems that we know of in underground work are the proposed new extension of the Edison Company, in New York, and the underground system of feeders proposed to be installed for the West End Railway, of Boston. The copper alone for the latter amounts to over $1,000,000; and this question of the cost of the copper calls my attention to a fact which I desire to notice, that much of this question of bugbear on copper is uncalled for when we are considering the underground system. The entire copper used on the system in Brooklyn is less than one-fifth of the cost of the underground system first installed.

I do not desire to claim that the ideas for the class of work here represented and described, hold or represent all the perfection to be obtained in central station work. There are many points contrary to the ideas here outlined, which are very desirable; I have merely tried to call your attention to what I consider good work in this particular line, and hope that it will result in bringing forth the discussions and additions which are very beneficial in the consideration of these problems in the results to be obtained, and I would only add a tribute to the powerful and master mind whose work, from the commencement of this field of central station distribution, has covered the leading problems and points, and whose ideas to-day represent much of the good and very little of the bad problems which we have in this work. I refer to Thomas A. Edison, whose work, commencing in this field on the old Pearl street station, in New York, over eight years ago, when the majority doubted and but few believed in its successful carrying out, and while we find that station until within the past few months, when it was partially destroyed, successfully working and, even antiquated as it was, earning large dividends. He has still continued actively to impregnate his ideas on the work from that day to this, although he has not taken such an active part in its carrying out, but I think we may see him, at no distant day, again taking a hand in this work, and bringing forth many new ideas in advancing the progress of the future.

MR. DE CAMP: I want to ask Mr. Field one question. I think in the early part of his paper the statement was made that the fixed expenses of the station was 75 per cent., and variable expenses, 25 per cent. May I ask just what is meant by "variable expenses"?

Mr. Field: Variable expenses are coal, lamp renewals, any increase in oil and any addition to the labor account.

Mr. De Camp: I presumed that was about it. Do you not keep extra pay rolls?

Mr. Field: No, sir. If we double our output, of course, our pay roll would increase to a certain extent.

Mr. De Camp: My understanding of it, as you stated it there was in making up your summary, that your fixed expenses were 75 per cent., and the variable expenses, 25 per cent.; and I inferred that was the actual fact. But there are what you term "variable expenses." Of course, there is an average on which you made them up.

Mr. Field: These are based on 5,000 lights connected, and are based on actual facts. But the labor account for that number of lights connected, goes into the fixed expenses. There is no variable labor account, or extra labor, or anything of that sort, if that is what you refer to. This is for 5,000 lights connected. We have 100 per cent. operating expenses, of which 75 per cent. is independent of the number of lights connected; and if we double that number of lights connected, making it 10,000, our operating expenses will increase, approximately, 25 per cent. I recognize the fact that estimates will vary in different stations, and to a different extent, according to their management and the way of working the operating force, etc.; but it is about the figure in stations of that class.

Mr. De Camp: I ask this for information. I believe they have me down for some remarks for something in that same line, and I would be pleased to have the gentleman present and criticise what I may have to say, because I think it is where a great many mistakes are made in this question of expenses. In my own judgment, I see no reason at all why there is any occasion for any estimate as to what expenses are; the expenses of running stations are fixed facts; they are ever present with you. While you may control your income absolutely, you can't control your expenses; that is, you have got to accept them as they appear to you, using due economy. But there are certain things that have got to be done. My own experience in arc stations. I have a great interest in incandescent work, because that I have yet to learn. But in arc stations, they are very regular indeed,

and any variation from a prior month's business can be noted at once without much trouble.

While I am here on my feet, I will say this, that I think that the theory—because I believe it is a theory—of the increase of expenses, the ratio of increase to expenses, is not properly appreciated. I believe it is very much greater—the ratio of increase to the ratio of expense, is very much greater than is generally supposed to be. I have had a little experience in that direction, and I draw my conclusion from that, and from considerable observation.

MR. FIELD: I have not drawn these conclusions from one station, or from theory. They are drawn from facts as they are represented, and facts as represented in a large number of other stations of the same class, based on actual results in them, in different lights, at different times in their history.

MR. A. P. SEYMOUR (of Syracuse, N. Y.): Mr. President, Mr. Field has covered the ground very thoroughly, I think. I am hardly prepared to discuss this matter, because my station is an arc light station. But it seems to me there is one rule that can be applied to all localities. That is to say, in different localities you cannot apply any specific rules; but there is the rule of using common sense, which can be applied everywhere and under all conditions to great advantage. Another rule that can be applied everywhere, is to do your work well. If you can't afford to do it well, don't do it at all. If you start out under the rule that you must do your work well, regardless of expense, you are sure to get economy and good results in the end.

In our station we are using Corliss engines. We used to use high speed engines, but we took them out and put in the Corliss engine, and we have found that our saving was about 52 per cent. in fuel; of course, we are in favor of the Corliss engine. Our conditions, of course, are different than they would be in an incandescent station.

MR. J. F. MUNSIE (of Brooklyn, N. Y.): Mr. President, I desire to ask Mr. Field a question. You claim that the Edison is the best for distribution?

MR. FIELD: I said for certain classes of work.

MR. MUNSIE: Well, for electric lighting distribution?

MR. FIELD: On lower tension circuits.

Mr. Munsie: Individual circuit distribution? We have an exhibition here which, I think, will clear up that assertion, without any more talk on it, and one which I think all the members of the Association should examine.

Mr. E. A. Armstrong (of Camden, N. J.): I understand, Mr. President, that Mr. De Camp said that he proposed to discuss this increase of cost in a paper he had. If not, I would like to ask Mr. Field a question. The matter of cost is a subject I am largely interested in.

Mr. De Camp: If you will allow me one minute. Mr. President, you have had me down there for three or four years on the methods of arriving at the cost of station product. While the title does not signify that this point would come in, it necessarily does come in in arriving at that cost. That is the reason why I asked Mr. Field for information, to enable me to be a little clearer in my explanation. I have always thought that it was one of the most important in itself in a central station, whose principal function is to make money, actual money for the company. Now, I have often said that the business of electric lighting was either one of progression or retrogression; that is, based upon my experience and observation. If you find the company that comes to a halt and settles down to a certain point, if you will watch it a little while, you will observe it is retrograding. The pressure upon you for electric lights and power is such that you have got to go on progressing. There is where comes in a very important element.

Mr. Field: When you come to make your estimate for the increase of capital to increase your plant, for your plant is capital, the question will arise, what are going to be the terms? If you base it on what I term, and I still think is largely theoretical, that the output of capital will give you an increased income at such an increased expense, that can be ascertained approximately. I think there are a great many mistakes made in that direction. I do not think there is a single portion you can figure down in a single plant.

Mr. Armstrong: It has been suggested to our general manager, and I recommend it to our board of directors, and your board resolved that it should appoint a committee. We now understand our expenses are so much, excepting the figures

that Mr. Field suggests, say, 75 per cent. In other words, assuming we were only earning enough to pay our cost, we were simply paying our way. I supposed by the expenditure of a little more of that which he has termed "variable expenses," that I could get a very large return, and I could double my receipts by the expenditure of a reasonable amount of money. I made it even less than that in my case. I could double my revenue by an increase of, say, 25 per cent. in my expenses; that was my understanding. If that is not so, then, it seems to me that electric lighting is rather a peculiar business. Of course, I do not profess to know anything about electricity, or much about the mechanical part of it. The only thing I am particularly anxiously looking for is the dollars and cents; that is what I am in the electric lighting business for. I am not a scientist; I do not profess to understand anything about that, but it seems to me that this is going to be one of the great businesses in the future. This Association represents one of the great businesses of the country, and, therefore, this point is something that we ought to have particularly cleared up. I am more pleased with this paper than anything I have heard here at the Convention. It seems to me, from my standpoint, one of the most practical things we have had presented, and if Mr. De Camp will take up that line and Mr. Field will assist in the criticisms that have been invited by Mr. De Camp, in the matter of these increased expenses as they are likely to be explained by further observation from the experience of the gentlemen here, that we may know what we may expect from our increased expenses, and that we can carry back from this Convention to our company a great deal of valuable information.

Mr. Field: I do not want to anticipate any ideas Mr. De Camp may have gathered from actual experience. I will say that I have been careful not to put in my paper any fact that might be misleading. I have endeavored to give actual results obtained from data, and results that I know are being obtained and have been obtained. And, in regard to that, some gentlemen brought up the point about increasing your plant, you have got to make an additional outlay; that outlay I have not considered at all. That outlay is going to vary under different conditions. If you increase your plant, you, of course, get an

additional income. I have assumed that increasing your outlay, your capital is going to increase proportionately and that you will not add a debt which you must pay interest on. That question of that proportion will be found in the class of work which I have outlined here on incandescent stations. I know stations which I could give by name where results are actually obtained, and where many of them have gone on the false idea that has been prevalent for several years, working just on the border land, having a good business, had not had the capacity to increase their business, or lacking management, where no increase of plant has been made, but where an increase of plant would have been followed by good results to the station and directors and stockholders. It is a proposition you have got to meet. You must get to business. You cannot go on the border land. You must do the same as the gas companies, and you will cut your operating expenses down to the small figure to which they have reduced theirs, compared to their income. It is only in that way that you will get the good result in your pay roll, in your labor account, and all those points that I have tried to outline. They are all very largely dependent on your business, on your plant.

MR. ALEXANDER: I think Mr. De Camp and Mr. Field are right in their respective ways. Mr. De Camp's experience has been with arc lights where an increased business does reach a largely increased cost of labor in them for repairing circuits, supplying carbons, etc., and things that Mr. Field does not have in the incandescent lamps. The operating expenses of a station need not be increased very much, or so much in the incandescent. I want to ask Mr. Field one question. He made one remark in his paper that within five months he had but one cross that they blew out, by which I suppose he meant that they burned it out. I want to ask this question, first, whether the third wire was grounded, and, secondly, whether he considers it safe to blow out a cross? I think if you do that you increase the danger of electric lighting considerably.

MR. DE CAMP: That is a very effective way of finding it.

MR. FIELD: That is treading a ground that I do not think has been thoroughly settled in the question of grounding the neutral wire on a three-wire system. It is a question that has not

yet arrived at a solution, yet it is a thing that has to be left to the individual judgment of each manager. It varies in different systems. You strike some old systems where they practically have not grounded their neutral wire owing to defects in their underground system. They have done that to avoid a cross between their outside two wires, as by grounding their neutral one, to come in between their positive and negative—when the "ground" wire attempted to come in between the positive and the negative, they would blow that off.

In answer to the question Mr. Alexander asked, about blowing off the ground, I think it is like this: When you get a heavy cross on your underground system, what are you going to do? It is going to play old Harry, and you have got to shut down or blow it off; that is all there is to it. I do not think you are taking any chances, that is, any great chances. I have seen a good many blown off, and I never knew them to give any trouble. They will make the lights shake for a few minutes, and then you will go on serving your customers, just as you did before, and take your time to hunt it up.

MR. DE CAMP: I once sent $2.50 in response to a circular of a gentleman who advertised a perfect way to find mistakes in a trial balance sheet. I got his rule, of which there were five or six columns, but there was a note following that wherein he said, "If this don't suffice, hunt for it." (Applause.)

THE PRESIDENT: I will call upon Mr. De Camp to present his paper on this topic.

MR. DECAMP: I desire a little further time for more definite information.

THE PRESIDENT: We will now receive from Mr. Smith his paper on the subject of Central Station Accounts.

Mr. T. Carpenter Smith, of Philadelphia, addressed the Convention on the subject of Central Station Accounts, etc.

A SYSTEM OF STATION ACCOUNTS.

BY T. CARPENTER SMITH.

Having asked and been asked many times as to the cost of producing electric lights, and having received and given answers which varied widely, without having any means of reducing them all to a common denomination, I have thought that some system of doing work and keeping cost might be devised which could be used in stations of any size, and at the same time

enable us to make fair comparisons between them. To do this it seems that we ought to have some general principles of doing work and carrying on the routine duty of the station, which principles should not be burdensome to stations of small capacity, but the details of which could be elaborated as the station increases its business, until it should finally result in a company being able, by a simple inspection of its books, to tell what it costs to do its work from day to day, and on just what items of its business it is making or losing money.

We all know that in the electric light business there are certain contracts which must be taken and work which must be done, from which no real return can be expected, and the problem is to know just how much we make or lose on each particular contract, in order to decide quickly whether the "game is worth the candle" for such cases. To find what is necessary to be done in the highest development of this method, I think the easiest plan will be to describe a system organized some years ago, which has stood the test of time and service, with the need of but few changes.

I do not wish to be understood as claiming that this system presents any great originality, since the most of it is only the application of methods of carrying on business which have been worked out from time to time. The application of some of these methods, however, to electric light station work, is, I believe, new.

The first main principle is dividing the staff into two distinct branches—the station and the office. This may not seem practicable in small stations, but I would explain that this has reference simply to the official capacities of the men.

In small stations it is very likely that one man will be a sort of "Pooh Bah," who fills many offices, but his lines of duty must be kept clearly distinct from one another. Without doubt, all companies have been more or less annoyed by the continuous waste of time and money from customers sending complaints to the station or having little odd jobs attended to, for which they never think they should pay. For such service it would cost the company more to collect the money due than the whole affair is worth; at the same time, one does not want to run the risk of offending an otherwise good customer by refusing to do an apparently trifling service.

By separating the office from the station, and having all complaints sent to the office, it simply makes it not quite so easy for the customer to demand anything of this kind, and any employé of the station who is doing work in a customer's establishment has for an answer to any request to do something outside of his regular duty, that he cannot do it without an order from the office, at the same time saying that no doubt that it will be all right if the customer will make proper application.

The office can very easily, when such inquiry is made, volunteer the suggestion that the work will cost but a trifle, not more than so many dollars and cents, which gives the customer at once to understand that he is expected to pay for it.

The office, under the direction of the secretary or general manager, and

their subordinates, makes all contracts, orders all supplies and receives all complaints; in fact, is the only communication of the company with the outside world.

The second main principle is, that no work is to be done or material used, except on a definite order, and all supplies used, all men's time and all expenses, are to be charged to this number, without any reference to what kind of job it may be on. Duplicate books are kept in the office, and in the superintendent's office at the station, in which the orders as they are determined upon are entered in regular routine, and the men working upon them do not need to know in the least who is to pay for the work, or in whose name it is being done; but all orders, requisitions, bills, etc., are charged to order No. "X." Any man doing work for which he has not a written authority and a proper number to charge the same to, is not paid for the work, and thus, men will very soon learn that this system will save an immense amount of time and trouble to themselves.

The third principle is that all supplies must be received and issued by the store room; whether it be a new engine or dynamo, or a sheet of crocus cloth, the store room must have the proper orders and receipts for such issue.

These principles being established, and the station ready to start—let us see what the first operation would be. A new order book being opened, order No. 1 made out in the office of the company, would read: "Operate boiler-room"; number 2, "operate engine room"; number 3, "operate arc apparatus"; number 4, "operate incandescent apparatus"; number 5, "operate power plant."

These orders would practically cover the running of the station, if it be desired to itemize as is shown above. Where it is not desired to separate the cost of operating each part of the plant, the whole might be classed under one order—"Operate the station."

The firemen, engineers, dynamo tenders, trimmers, etc., in fact, all who are employed on the regular routine work of the station, each receive a number of numbers from the foreman of their department, to which they charge their time from day to day, according to the hours spent on each separate item.

A contract, say No. 7, being made with a customer by the office, and the exact amount of work to be done by the company entered upon the form of the contract, the customer's signature is attached. A copy of the contract, detailing the amount of work and supplies to be furnished, is attached to a blank form, which is sent to the superintendent, and which is headed, "General order, No. 101," and might read, "Wire up John Jones' store for 60 incandescent lamps, as per terms of contract No. 7, hereto attached."

When arranging to make this contract, the office may have found that they have no pole line extending up the street on which this customer's store is located, and they will, therefore, have to make arrangements to build this pole line, and run the wire up to reach him; at the same time, they may find they have reached their limit of load on the various machines in the station. As the building of this line would probably give them a number of other cus-

tomers upon it, they decide that they will at once proceed with the placing of a new 150 horse-power engine and dynamos for it, and they accordingly proceed to order the new engine and dynamos, and make out two more orders, which might read, "General order, No. 102. Build pole line and string arc and incandescent circuit on 21st Street, to corner of High," and "Order No. 103. Set up new 150 horse-power engine in engine room, and connect it with the main steam pipe."

The other orders for setting up the dynamos and connecting to switchboard, would follow in a like manner.

These forms, signed by the secretary and general manager, are the superintendent's authority for proceeding with the work, and he proceeds to fill out other forms, which he delivers to the proper foremen. In this case, these forms would read:

"Superintendent's office. To Mr. Blank, foreman incandescent wiremen:

"Do the following work: Wire up Mr. John Jones' store, etc., as per slip attached hereto. All labor, material used, to be entered up on this form. General order, No. 101.".

This is placed upon the proper hook for the incandescent foreman, and constitutes his authority for all labor and supplies. The superintendent would then make out another order on the foreman of linemen, as follows:

"Mr. Blank, head lineman:

"Do the following work: Extend pole line, and run arc and incandescent wires up 21st Street, to corner of High. All materials and labor to be entered up on this form. General order, No. 102."

Also a third order to the chief engineer:

"Mr. Blank, chief engineer: Set up new 150 horse-power engine in engine room, and make proper connections to steam line. General Order No. 103."

If it is desired that this last work should be done by contract, the superintendent, it will be observed, can make this order instead of to his own chief engineer, to any contractor whom he may desire to employ; but he would make his order read: "Set up new 150 horse-power engine, etc., as per contract hereto attached," and would then have a regular contract drawn and attached to this form, which would still keep order number 103 as the one to which all expenses, etc., are to be charged.

Following out these three representative orders, we would say that each foreman carries a small "Foreman's order book," with the leaves divided into two parts. Any order written on the first half of one of these leaves, for materials, will be honored at the store room by whoever presents it, as long as it carries the foreman's signature, and the foreman for his own protection writes a duplicate order on the stub, which he keeps. These orders form the store keeper's voucher for all material issued, and the foreman who issued the order becomes responsible for the material as soon as it has passed the counter of the store room.

It is found very convenient to have these "Foremen's order books" printed on different colored paper, for the different departments.

The bookkeeper in the office, as soon as an order is entered in the order

book, and the proper orders sent to the superintendent to have it carried out, opens an account on his ledger with this order number, to which account are charged all material, supplies, etc., to be used, whether the company is to receive any money for the service or not.

When the foreman in charge of the work reports the order completed, the superintendent returns to the office the original order which he issued to the foreman, which has entered upon it all material, labor, etc., used ; after taking a press copy in a letter book, which he retains as his record of the cost. The ledger account is then closed up, and the company knows precisely what this work has cost them. If they are to be paid for it, it forms a basis of their bill ; if they are not to be paid for it, it lets them know how much money they have sunk in their construction account for this particular item.

This system of numbering orders does not extend to the accounts of the company, as entered in the ledger, except that in entering up accounts in the ledger it may be convenient sometimes to use order numbers for entering up items in an account ; such, for instance, as, if the company should have an account with John Jones as a customer, in John Jones' account it would only be necessary to say : "Construction as per general order number so and so," and the items of the bill can then be taken directly from the order which had originally been given to the superintendent, and which he would have returned to the office, with items of material and labor entered upon it.

While electric light companies should undoubtedly endeavor always to get rid of construction work, and simply sell current of a certain voltage at the customer's premises, up to date and for some time to come they will probably have to do a large amount of inside work. In such cases, the superintendent's order returned, with the material and labor items as above stated, can be filed directly with the contract, and in case of any question being raised by the customer, as to what material belongs to him, or to the company, a simple reference to the file will give this information.

All work of whatever kind done should be charged to some account in the ledger, and a convenient division of accounts to which items should be charged, will be found to be as follows :

Construction.—All poles, wire, insulators, cross-arms and other material used in the construction of lines, whether overhead or underground. All fixtures, cranes, sockets, or wiring for incandescent lamps ; and in general everything attached to a customer's premises, including any tools used for this work.

Machinery and Fixtures.—All dynamos and parts of same, belting, station instruments and switches, and all other movable apparatus in the station.

Motors.—Where the company own such.

Office Fixtures and Furniture.—Including all furniture in and about the station.

Station.—All real estate, buildings, engines, boilers, foundations, pumps, piping, shafting, and any fixed scales or machinery.

Patent and Legal Expenses.—Of every nature and kind.

Store Room.—All material and supplies of whatever kind to be charged to

the several departments as issued. These various items should be, of course, considered as unavailable assets.

In what are known generally as the "Expense Accounts," a convenient division will be found as follows:

Advertising.

Carbons.

Fuel.

Insurance.

Interest and Discount (if any).

Interest on Bonds and Mortgages.

Lighting Supplies, including incandescent lamps for renewals.

Shades and Globes for arc lamps, and Dynamo Brushes and other material of this nature.

Machinery Repairs.—All repairs to dynamos, armatures, station instruments or switches, arc lamps or parts of same.

Maintenance Repairs.—Being repairs to poles, lines, etc., converters in service, meters and other appliances used or located outside the station.

Shop and Station Repairs.—Repairs to buildings, boilers and engines, piping or any fixed machinery.

Printing and Stationery.—Of every kind and nature.

Salaries.—Of the officers of the company.

Wages.—Of the employés to be divided proportionately to each department, as explained above by the system of order numbers.

Oil and Waste.—Of every kind.

Taxes.—Of every kind.

Of course, many of these items can be put together under one head if desired. The extent to which the various accounts are to be itemized is a question for the decision of the company, but it must be remembered that in work of this kind, the more that is done in the way of saving labor, by having the books and forms printed, the less there will be left to fill in by the employés, and the more chance there will be of their doing so correctly. Especially should this be taken care of in arranging the forms for line foremen, since it is often very inconvenient for these men to fill out their forms when out in wet or dirty weather. A convenient arrangement for this purpose is to give the man a leather case, which will just hold one of the superintendent's orders, when doubled through the center, and an indelible pencil with which to sign their orders on the store keeper.

The only other account which is kept separately, is the store keeper's account. He should have what is practically a ledger, in which he enters up on one side of the page all material received, to the debit of the store room, and on the other side, all material issued, to the credit of the store room. He can thus have a page to each item of supplies, and having a column for the amount in stock, deduct as he issues each order, the amount of the order. He can tell at a glance how low his stock is running, which enables him to issue a requisition on the office, and have the material ordered in time to prevent running out, and insert returned items.

In order to prevent the necessity of foremen sending in three or four orders for small lots of material, it is better to have a system of "returned material" credits, so that a foreman who requires 500 or 600 feet of wire, can give his man an order on the store for a reel, the weight of which is taken when it leaves the store room. The work being completed, the balance of the wire can be returned to the store room, and the store keeper makes an entry on the stub of the order remaining in the foreman's order book, crediting him with so much material returned, and makes, of course, a corresponding entry in his report to the office. In the same way any material which is taken down and returned on the conclusion of a contract, is returned to the store room, and a credit given for it.

If the material is simply to be counted as scrap, it is sold, or set aside for sale, and entered up in the store room book in that way; but should the material be fit for other use, such as cranes for arc lamps, etc., they can be simply entered up as returned tools.

An excellent plan is to have a record book for all material, etc., in the station, the engines being distinguished by numbers; the dynamos, ditto, and all converters. The location of the engine is entered in the book, and the duty which it is doing, and any repairs made to it are charged up against it in this book. This may not seem of much importance, but in the case of converters, arc lamps, meters and such materials, it will be extremely valuble in keeping track of them.

Cases have occurred where converters have been removed from buildings when repairs have been made, and have been lost sight of for months, but a book of this kind enables them to be traced, since every change of location or repairs are entered in the book, consequently it is easy to follow them through their wanderings. Not only this, but it occasionally happens that one gets a lamp, or something of that kind, which is absolutely bad, that is, it seems to be perpetually needing repairs, and it may be that in such case it will be a good deal cheaper to simply consign it to the scrap heap and get rid of it entirely. In such cases, the one which takes its place can be known by the same number, and it will make no difference in the correctness of the record, since the fact that it is a new lamp will be found recorded on the page of the book devoted to that particular number.

In order to enable accounts to be kept correctly in the ledger, there must be, of course, some regular division of duties, which the men themselves should thoroughly understand, in order that in charging up their time they may be able to charge the proper number of hours to the proper accounts. In a large station, moreover, there must be, and will be always a certain amount of jealousy between the different gangs of men, and there is very apt to be some clashing owing to fancied encroachments of one gang on duties properly belonging to another. Arising, as this generally does, from an entirely mistaken notion, it is all the harder to combat, and the best way is to prevent it arising at all, if possible.

The division of duties, somewhat as follows, may be found of some assistance to this end: The superintendent is in full charge of the station, and all

work done by the company of any kind or description. If the station is large enough for the superintendent to require assistance in his duties, he should have a man who can attend generally to the making out of his orders, examining reports, etc., so as to take as much of the routine work as possible off his hands. In this way, during the superintendent's absence, his assistant, who needs be little more than a clerk, immediately takes his place, and while he may not be able to decide just how any particular piece of work should be done, he can often decide whether it shall be done at all or not, or whether it shall wait for the superintendent's return. Under the superintendent comes the chief engineer, chief dynamo man, chief lineman and chief incandescent wireman. Under the chief dynamo man come the various dynamo runners, although the chief engineer may also be able to take charge of the dynamo room, in which case, it would be made a department, so to speak, of the engine staff. Under the chief engineer come all the engineers, firemen, coal handlers, etc.

In the absence of the chief engineer, the engineer on watch takes his place and the same with regard to the dynamo man. The chief lineman should have under his care all pole lines and outside construction of all kinds, including all arc lamps and all high tension wires of any description ; also the care of converters to the first cut-out on the secondary side. He should also have charge of the carbon setters and arc patrolmen. The chief wireman should have charge of all low tension inside wires in buildings where such are under the control of the company, the care of all lamp renewals, incandescent patrolmen, and generally of all material and work from the first cut-out on the secondary side of the converters. The store keeper, of course, has his own duties separate from all of these.

The only reports necessary to be made will be found to be the engineer's log, for which there should be two books provided ; one for the day run and one for the night run, to be filled up by the engineer on watch, and turned in to the superintendent's office every morning for examination. In this should be entered the amount of coal burned, at what time each engine was started and stopped, and the other usual items ; the name of the engineer on duty, etc.

The dynamo room log should be much of the same style, but include a reading of the load on each machine, taken at 20 minutes' intervals throughout the whole run. This report, with the amount of coal burnt, gives an excellent check upon the fireman and upon the quality of the coal.

In one station, which is purely incandescent, this record has been so well kept that it has been the means of saving the company hundreds of dollars, since any perceptible increase in the amount of coal burnt per ampere hour, as shown by the engineer and dynamo room reports, is blamed at once upon the coal. This has resulted, in several instances, in the detection of a poorer quality of coal being furnished when the firemen using the coal were not able to detect the difference, but the coal dealers, on being taxed with the matter, fully owned up.

The various inspectors and patrolmen should fill out a printed form, giving

the number of arc lamps on the circuits they have charge of, if any of these lamps are out or burning badly, and between what hours, and the probable cause, so far as they can judge. It will be found much cheaper, however, to keep constantly on hand a few lamps known to be in good condition, and wherever an arc lamp does not work correctly, to take it out at once and bring it to the station for repairs, rather than let the inspectors attempt to fix it in place.

The store keeper should make a report daily of all material received and issued, which report can be used by the office as a check upon bills received for material, since the bills will be laid away until the store keeper's report shows that the material ordered has been received and in what condition, and if any expenses have been incurred which should be charged against the bill. The use of forms for all these various purposes will make the actual bookkeeping of the station very simple.

If the company is fortunate enough to be in a position to simply sell current and nothing else, their cost accounts will really be the bulk of their work. Should they, however, have to sell arc lights, the matter then becomes a trifle more complicated. The customer's account and bill will always be made up from his contract, renewals of lamps being charged up against his account as he receives them unless the company furnishes renewals, in which case, however, it is well to keep a record of renewals made, in order to put a check upon any excessive breakage. In some cases, the customers who receive renewals for nothing have been caught supplying a customer who had to pay for them, at half rates; or boys will bring in broken lamps for renewals for customers who are not entitled to them, giving the name of a customer who is, in order to get them for nothing. A convenient check upon this latter scheme is to have a small stamp to mark the butts of lamps, were it possible, or to have some secret mark upon the lamps to find whether they are issued from the company's office or not. This little device in one station has resulted in finding two or three people who made a regular practice of this kind of business, which, of course, was all dead loss to the company.

The forms for all these accounts will be found to vary greatly, according to the amount and kind of business the company is doing.

If a sufficient number of members of the Association think well enough of this method of keeping accounts to agree to use it, if it shall be put in workable shape for them, I shall be pleased to get up such a system of forms and furnish them to them. In many cases it is the amount of detail required to think out and work up such forms that prevents their being adopted, where if they could be obtained ready for use they would be gladly used.

THE PRESIDENT: As the hour is getting late, I think it will be well for us to adjourn shortly for lunch. Before we adjourn, I will announce that there will be a meeting of the Executive Committee, at the parlor of the Coates House, directly after the close of this session. The Secretary has received information of a communication from Mr. Whipple, general manager of the St.

Louis Exposition Company, the purport of which he will state to the Convention.

SECRETARY GARRATT: A letter was sent by Mr. Fred H. Whipple, general manager of the St. Louis Exposition Company, which has gone to the New York office. Its purport, however, I learn is this: The St. Louis Exposition Company has requested the American Institute of Electrical Engineers, The National Electric Light Association and the electrical fraternity at large, to each one appoint one of a committee of three; that is, our Association will appoint one of the committee, the American Institute will appoint another, and another will be chosen at large by correspondents. This committee will pass upon the awards of merit and the medals to be given at the St. Louis Exposition. I have just received a communication from Mr. Ralph W. Pope, secretary of the American Institute of Electrical Engineers, that Prof. Herring has been named by the American Institute as its member. It now devolves upon this Association to name its member.

MR. PERRY: I nominate Edwin R. Weeks, of Kansas City, as the representative in behalf of The National Electric Light Association.

The motion having been seconded by Mr. Hunter, was put by Mr. Perry, and unanimously carried.

The President, after returning his thanks to the Convention, said:

Before adjourning, the Secretary will distribute advance copies of several papers which will be our next order of business. After hearing from Mr. De Camp, we will have a discussion of the topic continued by Mr. Francisco, followed by others, and upon the close of that topic, we will have "Nine Years with the Arc Lamp," from Mr. Law, which paper the Secretary has had printed and will distribute to the members, so that you may look it over during the intermission and be prepared to take profitable part in the discussion of that subject. The Secretary has also had the papers of Mr. Haskins, of Chicago, on "Prodigality in Economy"; Prof. Thomson, on "Safety and Safety Devices in Electric Installations," and Mr. Pope, on "How our Paths may be made Paths of Peace," printed, and will distribute them now to the members of the Convention. When the

papers are read, they will be read by title, and the writers of the papers will have five minutes in which to call attention to important points, after which time will be given for general discussion.

Dr. Mason then moved to take a recess until 2.30 P. M., which motion was carried, and the Convention took an intermission until 2.30 o'clock, P. M.

AFTERNOON SESSION.

2.30 P. M., FEBRUARY 13TH, 1890.

The Convention was called to order by President Weeks, who introduced Mr. De Camp, of Philadelphia, who addressed the Convention on the subject of the

COST OF PRODUCTS TO CENTRAL STATIONS.

Mr. Chairman and Gentlemen: I have a few copies of the form of a statement here, which I did not bring for the purpose, but probably it will facilitate matters if those who are interested in following the oourse of what is said will look at these sheets and take part in the discussion.

The following is the form in which we endeavor to record cost of products with us:

REVENUE	AVERAGE COST.	AVERAGE REVENUE.
Lights,	....	....
Other Sources,	....	....
Total Revenue,	....	....
Less Rebates, etc.,	....	....
EXPENSES.		
Pay Roll, Electrical Department,	....	....
" Motive Power Department,	....	....
" Office,	....	....
General Stationery,	....	....
" Cartage,	....	....
" Expressage,	....	....
" Horses,	....	....
" Tools,	....	....
" Miscellaneous,	....	....
Taxes, Licenses, etc.,	....	....
Interest,	....	....
Extraordinary,	....	....
Total General Expenses,	....	....
Coal,	....	....

Carbons,	....	....
Engines, Oil (Machinery),	....	....
" " (Cylinder),	....	....
" Waste,	....	....
" Belts,	....	....
" Shafting,	....	....
" Miscellaneous,	....	....
Boilers, Furnaces,	....	....
" Tubes,	....	....
" Piping,	....	....
" Pumps,	....	....
" Miscellaneous,	....	....
Dynamos, Oil,	....	....
" Waste,	....	....
" Belts,	. ...	....
" Brushes,	....	....
" Armatures,	....	....
" Commutators,	....	....
" Segments,	....	.. ..
" Miscellaneous,	....	....
Lamps, Spools,	....	....
" Cut-outs,	....	....
" Armatures,	....	....
" Carbon Holders,	....	.. ..
" " Rods,	....	....
" Insulations,	....	....
" Globes,	....	....
" Miscellaneous,	....	....
" Incandescent,	....	....
Line, Poles,	....	....
" Wire,	....	....
" Miscellaneous,	....	....
Net Results,	....	....
Previously Reported,	....	....
Total for the Year,	....	....
Daily Average (Sundays excepted),	....	....
Sunday Average,	....	....

Total Hours Burned..........Average..........

I will say, Mr. Chairman, that this is a method which has been in use with our company since the first of January, 1886, without practically any change. That it has been in use that long, is owing to the fact that I have not myself been able to devise any better method of arriving at conclusion ; nor have I seen any form adopted by other companies, that I thought answered the purpose any better. I was practically without any

method of arriving at the result, from the time we started, in the Summer of 1884, up to the first of 1886; and then it occurred to me that we were a manufacturing company, differing in no essential from any other manufacturing company. That our business was the production of light, which we sold as a light. Therefore, we wanted to know the cost of that production, on the same principle that a manufacturer who made a yard of cloth and sold it on the market at a given price, wanted to know what it cost him as a whole. Further than that, in order to conduct his business properly, he wanted to know in what that cost consisted. It, therefore, remained for me to divide that cost up. In doing that, I bore in mind that there was a fault or a defect in too much detail. That any concern should at least have one head, who should be able at all times to appreciate and understand the condition of its business; one in whom they should confide to the uttermost. Otherwise, I should have spread this thing out in greater detail. In our own cases, as it existed then, we had three classes of products, all of them alike. The first were day lights running from 7.30 in the morning until six, and some of them up to ten at night. Next, evening lights, starting at three or four o'clock in the afternoon and running until 12. Next, all night lights, starting at six in the evening and running until, say, six o'clock in the morning. Each one of those three classes lapped into the other. It was utterly impossible, so far as I could see, to find just exactly what was the relative cost of those three classes of products. Not seeing a way clear to do that, I knew of no better way than to strike a general average. Those of you who have this memorandum, I have to refer to it by numbers. As a preliminary to this, or as auxiliary to this, it does not enter into the subject which I propose to confine myself to, is our regular record. I think we have a pretty good way of doing it; I do not know as there is a better way. Our business is divided up into the three classes of business. Those reports come in to me at the office, and the report shows that we rent a certain number of lights from seven in the morning until six in the afternoon, aggregating a number of hours so much. The same with the evening, and the same with the all night lights. This report is made out at the end of every month. In order to make that, we take the aggregate number of lights

and aggregate number of hours. We put in our first line the number of lights. We carry into the second column over to the left, what we had charged for those lights, what our light account stands charged with for that month. We have there other sources that are hardly worth mentioning; but it is to cover a little motor service which we have, not as a power service, it only amounts to four or five hundred dollars a month. We convert that into what is equivalent to lamp service, by taking the average returns of our lamp per month, which would be 15 or 10, or 12, whatever it is, and divide it up into that amount, and call it so many lamps. These motors are all run in the service rendered by the day service or its equivalent. Then we deduct from that amount which we have charged against the lamp account, all rebate, discounts, and all claims of whatever character that have been presented to us during that month, and which have been accepted and deducted from that amount, and carry into our outside column the remainder, which gives us our charge against the light account. Now, we have in our method the charge for lights and schedule of prices. It is based on the service rendered. For day service we charge so much ; for evening service we charge so much, and for all night service so much per light. But that rate is again charged each kind of contract the party gives us. The best contract we can get, in our estimation, is a contract that runs for 12 months, and in which contract we make the lowest price, as the short contracts are almost invariably made to cover the Winter months of the year, which are the most valuable months of the year. For instance, if we have a contract for six months, from the first of October to the first of April, we have put out of our possession a lamp, and get only a certain revenue for six months. At the end of six months, that lamp is thrown back on our hands again and we are deprived of any additional revenue. Consequently, all that we can calculate against that lamp is that that service is the service that that lamp renders us for that 12 months, which is our fiscal year.

Now, for that class of service we charge a higher price. In order to get the average, we take that total amount charged against lights, take the total number of lights charged during the month and divide it into that number, and it gives us our

average cost and average price received for lights during that month.

So much for the starting point, which is our revenue account. Of course, to get at that we have to deduct our expenses. Our method of arriving at the cost of these lights is precisely the method of arriving at our revenue. It is an average cost. By dividing our total expenses by the total number of lights which we have divided into our total income, we get the average revenue from the lamps. That certainly, as a whole, I think, is an undisputed way of arriving at the cost of that product, and the average revenue received from it.

In regard to arriving at the average price received, that is arbitrary. There can be very little chance of making a mistake in that, but in the other there is great room for mistakes or discrepancies.

Now, having arrived at that cost of production, no man can prosecute his business and take care of it without being familiar with the various items of which that cost is made up. I have seen fit to divide that under, first, pay roll; second, general expenses; third, taxes; fourth, interest; fifth, extraordinary; sixth, coal; seventh, carbon; eighth, engines (I mean by that repairs and maintenance); ninth, dynamo; tenth, lamps; eleventh, lines. Now, those are our general heads of items under which we group our costs. This statement is made up for my own particular use, and for any other who sees fit to use it; but as they go into a detail which the average officer of a company has not the time or disposition to take up, they are not material to this statement, but for explanation here I will say we divide the pay rolls into three classes; first, the electrical department, which pertains to all matters under the electrical head, or general superintendence; second, the motive power department, which pertains to all matters in charge of our chief engineer; third, office pay roll, which has been in my own particular department. The general expense we group into stationery, carts, expressage, freights, horses, tools and miscellaneous items. This generalizing can be extended almost indefinitely. Taxes, we cover into that, state, municipal, water rents, insurance, our license charges, and I believe that is all. They appear on our books, not under separate heads, but as separate charges, with

the understanding that they go into the general books of account. The interest account covers any fixed charges of interest, either as against us or credits where we have made discounts. The extraordinary account means simply this: It is the experience of every corporation—certainly my experience for a number of years—that we have never yet had a year in which we have not been subject to some expense, some charge, which we could not foresee at the commencement of the year, such as legal expenses, damages, and such things as that.

Now, I will stop there, as our expenses are divided there, and call them all the general expenses. In regard to these three items, I will have to go back a little to explain that to you. When we get to the end of this month, which we always take on the first day of the month, and our books are ruled in sheets for that purpose, on the first day of the month you can go and get the result. I am prepared to say that I will give any of our board a check or cash for that return at any time. They can have it. They can keep it. I do not want it. That is what I mean by the absolute net revenue of the corporation.

That you may make comparisons from one year to another without trouble, you have got to, in some way, eliminate these three unknown factors, taxes, interest and extraordinary expenses. In the City of Philadelphia, the bulk of our taxes, in order to get the benefits of what discount can be had by prompt payment, should be paid, or at least three-fourths of them should be paid, in the first three months of the year, and it is a very considerable item. I think that our taxes in Philadelphia, coming under that head, amount to about $15,000 in the course of a year, and the result would be, if you had them charged off at the time that they were paid, that you would have a variable result, from month to month, on your returns. The same way with the interest account, and the extraordinary account; therefore, at the commencement of the year, I think, this is a wise and convenient way of handling those three subjects. I refer to the year previous; I see what they are. If the tax account has been so much, I divide it by 12, as there are 12 months in a year. That one-twelfth I charge off every month, having an account on the ledger with those three items, and debit and credit these accounts. Experience enables me to see how I am coming out at

the end of the year. I seldom get more than $300 or $400 out of the way, one way or the other. That method of charging the proportionate amount off every month enables you to keep the correct run of your business.

The total account we divide the same way by the number of lights, and the same way with carbon.

Engines I have subdivided again into machinery oil, cylinder oil, waste, belts, shafting and miscellaneous expenses. We have to draw the line somewhere on the charges on this expense, and, therefore, we make a rule where this line shall be drawn, that is known to everybody whose business it is to make these charges. For instance, on the engine—all belts, such as counter belts, main belts on the engine, and anything up to the belts that goes to the dynamo, is charged against the engine account. The shafting expenses—all repairs to that is charged to the engine, and the pulley, and everything of that kind. Boilers, and all repairs to furnaces, the repairs to tools, piping and the pumps, and all other items which are innumerable, are classed under the head of miscellaneous. Dynamos I subdivide into oil, waste, belts, brushes, armatures, commutators, segments and miscellaneous items. Lamps I divide into spools, cut-outs, armatures, carbon holders, carbon rods, insulators, globes, miscellaneous and incandescent expenses. The incandescent expenses are put in there because our expenses on that are so small that they do not amount to anything. The line expense we divide into poles, wire and miscellaneous items.

Our books are so ruled that they correspond to every one of these items. The store keeper has charge of all these supplies, which he has got by reason of making the proper request for them of the purchasing officer. When this account is summed up, at the end of the month, we take each one of these departments, having found what the total expense is. There is no getting away from that. We have to pay that amount. Now, it is to be divided among these different things. The result of it is that I think any one who would go over these statements, for the last two years particularly, would be struck with the uniformity of the expenses under these different heads. If any one month shows a marked increase of expenses on any particular item, it is very short work to put your finger right on it. I do not think

it is worth while for me to go into the starting points of these. Mr. Smith gave you that very clearly. His idea, as expressed in his paper, of handling that part and getting his stock out into the proper channel, is very good and does not differ very materially from our own way of doing it, but when we get this through we have got in that statement every manner and form of expense that it is possible for us to incur, and certainly all the money that we have spent. You may have an expense item against your engines this month of five times what it was last month, and five times what the average has been. It may be caused, as it was in one of our statements recently, by having to rip out the cylinder. There was an expense of three or four hundred dollars in that particular item, more than it had been for the year previous, but that immediately goes into the expense account; it is not a continued expense; it is not, as Mr. Field termed it, variable expense. It is an extraordinary expense in one particular item, and such expenses are bound to come sooner or latter. Following that through and to go into the details, which is the value of this paper, in my judgment, nothing can go without constant watching, but if I see that the cost of our lights is running along uniformly from month to month, my interest in that statement is a general one. If I find that the increase in cost for one month has been 10 per cent. or 15 per cent., I want to know why. I immediately go to these points and see. If it is not a legitimate increase I cannot help it, but I do know that it has gone into the expense account, and that is the end of it. If it shows a decrease I am interested in that, because if it is a legitimate decrease in the cost of that product, I want to see if can be maintained. If it is a decrease in some little peculiarity in that month's business, of course, I regret it is such. If you would follow that out and subdivide the expenses and have your two columns of average cost and average revenue, and compare them from month to month, I know no better way of keeping track of your business, nor any better way of educating yourself up to the true state of your own affairs than that. Of course, these results are governed somewhat by the amount of service you are rendering. If you find from the statement this month, 50,000 lights total an hour, cost so much, and our average run on those lights is 12 hours, and next month our

average run for the same number of lights is 10 hours, and our cost is reduced correspondingly, then we have made no particular progress. The expense has got the benefit of a shorter run. The purpose of this sheet is the use that I make of it in turning it into a Board of Directors, who know what they want, and what they want is the net result of your statement. But for the guidance of others, who are responsible for running the station, you have got to go into further details. You take the whole number of hours burned as an aggregate. In some of our statements it is $600,000. That will enable you with very little work to find out what it costs you per hour to run your lights. I do not think it signifies anything at all, so far as enabling you to fix the price of selling your product, but it does enable the engineer to say, "Last month our coal cost us half a cent an hour, or for ten hours five cents," and next month he comes and says, it cost four and a half. That is all right, but if it has been because of the relative difference in the nature of the service he has rendered, it does not amount to anything, but it is a point which aids the party who is to do this work to carry it out. I am not going to say anything more on this, but I do want the thing criticised. I had rather have the time taken up by criticism than anything I have to say.

There is another point in this, all of our supplies are drawn out of what we call the merchandise account. The instructions to the store keeper are, as our sales to outside parties are a very small matter, that it does not amount to enough to think of going into it. Of course, we sell some little things, and sell them at a profit when we can, but in charging these things out for our own use the instructions are to charge them at cost, in one sense, but a perfected cost; to give the company the benefit of a little margin, to cover waste and things of that kind. For instance, it is our custom, if wire cost 16¾ cents, to charge it to our own account at 17 cents, making, nominally, a profit of one-quarter of a cent on that wire. We fix the value on our merchandise stock at such an amount only as is necessary to keep us supplied in our business. For instance, we say $5,000 of stock is enough for this purpose. We have a merchandise account on our ledger. It stands at $5,000. If we charge everything out to it at cost, and put everything into it at cost, the difference between our

sales and what we put in should represent the difference between our two balances at the end of each month. I cannot always do it, but if a rule of that kind is followed, and I come in this month and look at our merchandise balance, I go to the store keeper, and say: "You seem to have $1,000 more stock than you had last month. What has been bought?" If it cannot be accounted for without much trouble I want an account of that stock taken. If it is the other way, and shows the decrease of $1,000 or some amount which, I think, is out of the usual order of things, I want to know in what particular it has been reduced. If it cannot be pointed out, an account of stock ought to be taken. We take an account of stock every six months. The custom of charging a slight margin on the stock against ourselves has always resulted, and always should result, in a credit balance at the end of the year, or six months, when we take stock. In the eight or nine years that I have been running business in that way, there has always been a margin over and above what I have reported from month to month on this paper. Another thing, if you keep your stock down to the minimum, and they chuck the whole thing overboard, they cannot hurt you very much. My policy is to keep a low stock, just large enough not to interfere with the means of running the business. That method of keeping your books gives you a certain basis for the cost of your lights. It gives you certain returns which you can rely upon as accurate, and it is very easily kept, and if Mr. Field is here I want to say again that I see no harm in that method of keeping your accounts for variable expenses. The expenses vary from month to month, undoubtedly, but nothing that should enter into a general report.

Another matter that I asked for time on this morning, but have not made much headway on, is this: It is a mistake that your income from increase in business so far outstrips increase in the cost of production. I am giving this from memory, as I did not think the matter would come up, and have not my notes, but I am not a great ways out of the way. I say, take a respectable sized station; 600 lights increased to 800, which is an increase of 33 per cent., results in an increase in cost of 10 per cent. An increase of 25 per cent., that is, from 800 to 1,000, results in an increase of 8 per cent. in cost. An increase again of 20 per cent. results in an increased cost of 7 per cent.

Now, that is pretty nearly correct. We have thought of it. I know there was a time in our history when we started with 320 lights, I think, and we had so much expense. It was thought when we doubled it we would have a very slight increased expense. Well, we did double it, and we did not double the expenses; but it did treble the expenses we expected to have; and that has kept right along, and I do not know how to check it. That is all I have to say at present. If I have not made myself clear on any of these particular points, I will be glad to do so.

Mr. Francisco: I consider this matter of central station accounts as one of the most important subjects that a central station man has to deal with. During the past year I traveled over quite a section of country, extending from Boston to Washington Territory in the Northwest, as far South as this city, taking in nearly all the stations, numbering several hundred. In the course of interviews with the station men at the different places, I looked up this matter of accounts. I found that a large number, in fact, the greater portion of the ordinary stations, what we call the smaller stations, kept no account whatever. They would start their plants, their engines and lights, and at the end of a year they struck a balance. In a great many cases they found the balance was on the wrong side, but they could not tell where it went to, or anything about it. Now, of course, in running an electric light plant, these things must be considered. I have adopted almost identically the plan presented by Mr. De Camp, although I never saw his, or never knew anything about his plan, until now. But for two years I have worked on this plan. I have it arranged for the incandescent light. I have also an incandescent system, and have inserted columns that show that. At the end of the month the figures can be inserted, and that is all you have got to do. Now, of course, if I am running an electric light plant, and I find that Mr. De Camp is running his light for a certain cost per light, while mine costs me one-third more, there must be some reason for it. In keeping an account like this, you can trace out where your leak is and solve it. For illustration: I take an account of coal. Every pound of coal that goes into my furnace every night is weighed. What we burn from the time we start to 12

o'clock is weighed, and what we burn from 12 o'clock until morning the same, and we get the average per hour. Now, awhile ago I was away from home, and when I came back and the reports were handed into me, I found that the coal accounts were far above what they ought to be. I called upon the engineer for an explanation of it. He said, "I do not know what the reason is. We have been running just the same way." I went to work after I had investigated the thing awhile, and telephoned for the coal man, and asked him if he would not call at the office, and when he came up I showed him the result. I said, "There is so much money that you want to give us credit for on our coal account." He could not, of course, see it as I did, but, nevertheless, he gave us credit, and there we saved several hundred dollars. It is just as Mr. Smith stated this morning. There is one benefit to a central station man in keeping an account. I know in running these small stations, the men cannot keep an account like they do at the large ones, because there are many stations where a man has to perform all the duties from president down to errand boy. Of course, he can simplify the matter to a great extent. In keeping his account he can collect the different items and get some idea of what it costs. If the central station men will adopt this plan throughout the United States, all those who belong to this Association, it will be of great assistance. I believe that every central station man above all things ought to keep these accounts. That has been my hobby for a great many years, "accounts." I have seen the benefits to be derived from keeping accounts many times, and especially in this business, because there are so many places where, if you do not keep track of your expenses in those things, it is going to eat you up. Of course, in running a business, it does not take but a little while to eat up dividends, if there is waste. The moment your disbursements exceed your receipts you get a howl from the stockholders, and the question for us to consider is how we are going to prevent it, if we do not know exactly what we are doing.

MR. C. J. FIELD: There is something I want to try and make a little clear. The stations which I have taken my basis from have been incandescent stations, while the stations Mr. De Camp has referred to are arc light stations. That will explain much

of the apparent difference in the result which I have mentioned and which Mr. De Camp has given.

Another thing, he says—he don't say where—on his list here, he gets his fixed expenses and variable expenses. I will say the stations I have been familiar with that kept such an account as this are incandescent instead of arc stations, but the principle is largely similar to the basis on which I figure the fixed expenses and variable expenses. They are from different stations, and are the actual results for different years, with different lights. I did not put in, in variable expenses, any expense of a break-down, or for armatures and dynamos, or anything else. That is all in your general operating expenses. My variable expenses were those expenses which you get by taking a station account, for instance, last year, when it had 10,000 lights on, and taking it again the 1st of January, when it had 20,000 lights on, seeing that you had a fair comparison, and seeing that there was included all those other charges which it is practicable to observe, and charging up an average over the 12 months. I know we have done it in our station, and have made an average. The month I have taken is a fair representative month, and shows a comparison on which we can rely without any danger of incorrectness. It shows us the practical information which we want. That is the information which we want to lay before the Board of Directors. Take a fair representative month, which will give you a true average, and that is the information which we want to go to the company with, that is not doing well, whom we want to convince that what they need is to put a little more push into their business ; that they want to spend a few thousand dollars more on construction to increase their capital and get onto a good basis. I think these are facts, although they may not be able to be tried by every electric light company in this Association. Each individual parent company, that is, the representative ones, should look a little more after their local company ; should look a little more after getting monthly reports from them, and keeping inspectors out, looking after them to see what they are doing. Then as to publishing these reports. There is one company who takes the reports from 100 or 200 of their central stations, not the details, but the general expenses, their operating expenses and earnings, and publishing it each month for the

benefit of their other station, so they can look over and see whether they are doing as well. From this it will be seen that one station is using so much coal, and producing a given result. Of course, there are local conditions. One place gets coal at ten cents per ton, and another place pays five dollars per ton, and there are those things that must be taken into consideration. But when you take into consideration all these things, you are going to get at a result that will show where your mistakes are, show where your men are not doing right, and point out the remedy to correct the errors that will enable you to get the result you are after.

In regard to the proportion of variable and fixed expenses, I will say, that since this morning, I have been looking up a few facts and data, and I find one large station is down as low into variable expenses as only 21 per cent. of the total expenses. In other words, that station has doubled its business, and has only increased its expense 21 per cent. Of course, these things are going to vary, but there will not be such a great variance as but what the matter can be equalized, and you can arrive at a pretty fair result. I think, at the last Convention, at Niagara, there was a committee appointed, Mr. Foote, if I remember right, of Cincinnati, who was going to prepare for the benefit of the Association a simple set of operating accounts and expenses. I do not know what has been done with that; but it seems to me that the Edison Association has done that, and have found it a great benefit. They publish it for their own people. It seems to me, it is going to be of much use to the members of this Association; it is going to bring this Association to that basis where it can be supported more and more, and give the true benefit to its members for which it was established. If anything has not been done in the matter of these accounts, why, I think it should be taken up and pushed.

MR. H. W. LEONARD (of New York): If I understood Mr. De Camp correctly, I think the figures he gave illustrated themselves, the point which he apparently has not seen. If I understood his figures correctly, he gave as an instance that a station running 600 lamps, increased to 800 lamps, increased its operating expenses about 10 per cent. Is that correct, Mr. De Camp?

MR. DE CAMP: The operating expenses decreased 10 per cent. per light.

MR. LEONARD: A decrease per lamp?

MR. DE CAMP: Yes, sir.

MR. LEONARD: The lamps were increased from 600 to 800, and it gave an increase of 10 per cent.?

MR. DE CAMP: It was in this way: By that increase of business, we made what lights we did make at 10 per cent. less each; it cost us 10 per cent. less per light. Now, Mr. Chairman, if I am permitted under this rule, I would like to say——

MR. T. C. SMITH (of Philadelphia): I would like to say a few words before Mr. De Camp speaks, because I think he will want to reply to the point I make. I think, if we want to get comparison between central stations, there is one thing that must be eliminated, and that is the dollars and cents of the question. It is all very well for us to meet here to help one another if we can. But there is an inborn objection to letting anybody else know our business. If another central station man comes to me and says, "How many cents or fractions of a cent does it cost you to produce one 16 candle-power for an hour?" it is very likely I won't tell him. But if he says to me, "Taking your fuel, your rent, your taxes, your affairs, and so on. Taking those different items as amounting to 100, how many of that 100 do you charge for fuel?" I am perfectly willing to give it to him, because that don't tell him what it is costing me; it is giving the percentage of cost, and I have no objection to doing that. Now, if central stations all over the country work in that way, the man in Albany finds his lamps are costing him 20 per cent. of the total operating expenses for fuel. Another man in some other town, who pays precisely the same price for coal, finds his fuel account is 30 or 40, instead of 20, he realizes there is something wrong, and in this way they can correct the evil. It may be in the one case, that the man is using a compound condensing engine and in the other a high speed engine. In one case he may be using coal that cost him a dollar a ton, and in the other case, coal that cost him four dollars a ton, and yet the man who is using a high price coal will get the best result. We use a coal which costs us a dollar a ton more than some others we could get, and count it the cheapest, because the item of hauling away the ashes with us is very heavy.

I have been asked several times how to handle the depreciation account. I do not know of any better way of doing that than by having no extraordinary account but one repair account, the repairs cost so much from year to year. The fact that we have a smash-up, and repairs cost us a little more for one particular month, ought not to have any effect with the directors when it was explained that there was a break-down. But, if at the end of the year it would appear they were too much, they should be looked into. We should want to keep our account near the point which was settled upon as about the true basis. That is to say, every time there is put in a new engine or a new dynamo or a new boiler in addition plant, it should be charged to the construction account. But when you find that the engine is worn out and you want to change it, you charge the new engine to repairs and sell your old one for what it will bring. The only increase in your capital account are your legitimate construction expenses. It is the same in a pole line. If a new pole goes in where there was a pole before, that is charged to repairs. If it is a new pole in a new place it is charged to construction.

THE PRESIDENT: If you will pardon me, Mr. Smith, what do you do if there is a change in the market value of material?

MR. SMITH: That you will have to charge to repairs the same way. You will get the benefit of the cost when you put in a new machine. The new machine is going to cost you less than the old one did, consequently, you will not charge so much for depreciation.

THE PRESIDENT: To illustrate that: We can all remember when a sewing machine cost from $100 to $150, while we can now buy them at from $10 to $30. Will not the same be true, to a considerable extent, with regard to electrical apparatus? What will you do with that shrinkage?

MR. SMITH: If you bought a dynamo, for which you paid $1,000, the first year it is worth $1,000. Every year your dynamo decreases in value; it gets worn out. When you get your new dynamo in, you get it for less money. Your capital account remains the same. You have either to make a gradual drop in the value of your plant; in making your annual statement, take an estimation of the value of the plant. I want to get rid of the

depreciation account, by making it all repairs. If you can buy your machine for that much less money, I think it simply means that your repairs have been less for that year. Considering your plant worth as much as it was originally, because your repair account has come down every year, and your plant is worth more in its capitalization than a plant which costs a greater amount. I think one will be fully offset by the other.

MR. DE CAMP: On that point that Mr. Smith just spoke about. A rule, which I think is a good one in this depreciation account, is this: The depreciation account is an unknown quantity; it is a conservative way of guessing at things, or keeping account. A rule like this will always enable you to be on the safe side. Merely incidental repairs are not things that affect it one way or the other. But when it comes to the general repairs, and you work on this principle, if after those repairs are made, is your engine, or your dynamo, or your boiler, as good as new? Then your construction account is not affected. Overlook all charges, or all depreciations, if not connected with any general expenditure of money.

MR. SMITH: I would explain, in speaking of the capital account, I did not make it quite clear. Of course, the capital account is always a liability, I mean in estimating your assets. It would be a simple way to keep these assets from year to year, to put them in at the value you think they could be replaced for to-day.

MR. DE CAMP: The other point I wanted to speak of was this: It is a good rule, it is a safe rule, it is a safer rule than no rule; but it is one of these rules that has an exception. When you get an engine that requires a general overhauling, you make your estimate that it is going to cost so much to repair it. If it is an amount worth taking into consideration, from that standpoint, make your engine as good as new. What follows? A new engine; charge your new engine at the lowest price you could buy it for, into your construction account. Give your construction account credit for what you can get out of your old one. That is an easy way to keep that. The construction account, of course, that is a by-word in all corporations, and it covers a multitude of sins. I have never put it in practice, but I have had the result worked out, and I am inclined to think

the rule which I state is a good one for maintaining the value. For instance, you have an electric light plant—an arc lamp is the only one I am talking about, as I understand it. That plant is made up of engines, boilers, dynamos, lamps, lines and general station construction. I think this would be a good plan to maintain your construction account: Make your calculation what your plant is worth in income power per lamp, because your lamp is what produces your income, and nothing else. Ascertain what it costs per lamp per dynamo capacity, boiler power, engine and dynamo. Fix it in some way, say $200 for a central station, that your plant is worth $300 a lamp. Well, you may have an engine capacity of twice as much as you have got lamp capacity; credit that with that amount. Now, on your construction account on your books, fix the basis of $300, or any other amount which you in your judgment think is a proper amount, or that the construction account can stand. Go on, and charge to your construction account any addition during the year, and give it due credit. It is like anything else; it is entitled to its proper credit. Then take your balance at the end of the year and see whether you have exceeded your estimate of what you thought your construction account would be. If it is increased ten per cent., why, charge it off. It will make your surplus, or your profit and loss account, that much less. If you assume that the market value of your plant is a certain amount, do not imagine it can always remain that way. If the price of construction is decreased, then you have to reconstruct your construction account because your plant is not worth that much. Now, the rule is to charge that amount of depreciation into your expenses and get rid of it every day, instead of having a yearly account, and you cannot make any very great mistake.

MR. F. A. WYMAN (of Boston): My experience has been that this so-called construction account should be called a destruction account. This running of expenses into the construction account destroys or ruins more people than any other item in the business. It does not seem to me right to build a new station, run it ten years, let it pay ten per cent. per annum, and, at the end of ten years, have to build it completely over again; so that your plant is only worth 50 cents on the dollar. It seems to me it is better to start out and pay a five per cent. dividend, and

charge the other five per cent. to depreciation. Of course, it takes courage to charge this up. A party making lights very cheap, and having exclusive control of a city where they are getting a high price, tries to make his operating expenses as large as they possibly can be made, but in a small town, where there is only a small dynamo capacity, they try to make their construction account as large as it can be. You have to steer between the two. I want to give you a practical illustration. About 20 years ago, there was a gas plant started in a good sized town in the East, with $100,000 capital. The other day, in looking it up, we found they had a paid-in capital of $35,000. They had $35,000 worth of property left. The other $65,000 had been paid away in dividends. They hadn't kept any depreciation account; it all went into the construction account. I wanted to ask Mr. De Camp in regard to the taxes; I understand him $15,000 a year. Now, I would like to ask if he meters his water? Does he buy water by meter?

Mr. De Camp: Yes, sir.

Mr. Wyman: Why should not that be charged every month, the same as you charge your coal?

Mr. De Camp: No reason why it should not be done. It is a matter of detail. In our case we get our water every month, and in this appropriation that we make for that particular account we include that. I think I can come within $50 a year of it, without being obliged to go and take the register of the meter, as we have no check from that department, which only takes the register every three months.

Mr. Wyman: Does it cost you more to run a light in the Winter or in the Summer?

Mr. De Camp: It costs us more in Winter, because the hours are longer. Our average run in Winter is longer.

Mr. Wyman: I mean hour by hour. Does it cost you more to run in the month of July than in December, or does it cost you more to run in the month of December than in July?

Mr. De Camp: I do not think I could answer that question. I do not think it does, but mainly for this reason: The month of July is our short month; that is, we are running at the smallest number of lights. During the month of December we are running, if we are running at all at any time during the 12 months,

we are running everything we have got, and we have the benefit of having everything utilized; and, consequently, taking the month of December for the last six years and comparing it with July, I would rather be inclined to think that the average cost was less per light for the month of December than for July; but mainly for that reason.

MR. WYMAN: On account of the use of all your plant?

MR. DE CAMP: On account of having that plant fully occupied, and running at is best capacity. For instance, one plant we have is 1,400 horse-power. That is utilized, and the labor and everything connected with it. There is nothing wasted, because we have all the means there for it. Our returns would probably be reduced 25 per cent. in July, but I think I am right in saying that the cost per light for the month of December would be less than it would in July.

MR. WYMAN: Do you keep a separate account between your outside and inside wiring?

MR. DE CAMP: You understand I am talking about arc lighting. What do you mean by "inside wiring"?

MR. WYMAN: I mean where you have to put wires inside and outside, both. Do you keep separate accounts of them?

MR. DE CAMP: Yes, sir.

MR. WYMAN: Do you keep separate accounts for both?

MR. DE CAMP: Yes, sir. We get an order to put in three or four lamps in a building. We cut it in off a line already established there, and it costs us simply for making that particular installation.

MR. WYMAN: Do you think that the inside wiring should go into current expense or construction account?

MR. DE CAMP: We put the wiring that goes in there into our construction account. That is a matter in which I sit in judgment upon it. It is according to what it is; but our rule is to charge everything that goes in there. Anything that is likely to be lost, and all the labor, is charged to expense. Now, I do not think that is far out of the way. Before I established that rule, I went over a large number of cases and found where I had taken out a wire and fixed the thing up at that particular point, that the losses on that account seldom exceeded five per cent. There is no danger if it is properly looked after, and, in regard to that, I say

it takes somewhat more than an ordinary clerk's interest in the matter to pass judgment upon it. In some cases I have struck it off entirely and charged it to expense account, because I thought the likelihood of getting anything out of it was very small. Of course, that which is returned is second-hand, and if we get that second-hand material back it does not go into our stock as new stock. Some of it gets right into the scrap heap. Our store keeper has the discretion to put it in there at what he thinks is a full valuation.

MR. BURLEIGH (of Camden, N. J.): I think there should be no such an account as a depreciation account. In arriving at that calculation I was interested in watching the plan of the Pennsylvania Railroad Company, who have given a great deal of attention to accounts and the best plan of arriving at values, and they do not have any depreciation account. They aim to keep their road and its equipment up to the standard all the time, and charge it to expense. Anything new that aids their railroad is charged to capital, and that which replaces what is worn out is charged to expenses. There is no such thing in their accounts as a depreciation account.

THE CHAIR: What do they do in case of change in market value? Do they make any allowance for that?

MR. BURLEIGH: No, sir, they do not. Take the case of a locomotive, which is valued as scrap at, perhaps, $1,000. That is replaced with a new engine costing $8,000. The $8,000 is charged to expenses. They aim to keep their railroad and its equipments all the time up to the capital value.

MR. WYMAN: I would like to ask Mr. Burleigh, if the Pennsylvania Railroad Company has established the value of their road on the earning capacity of the road? Is that the standard that they use? With us, we do not know what the earning capacity is going to be this year and next year. If the Pennsylvania Railroad Company, for instance, declares a four per cent. dividend, then their stock would sell at 1.25; if at six per cent., they would be selling at 1.75. They do not take account of stock as we do in the electric light business. They say: "We have got an earning capacity of so much, and the value we had 30 to 40 years ago has nothing to do with it at all. We will earn that next year, consequently, our construction account is all right." I do not see how we can compare with them.

Mr. Burleigh: They know exactly what they have got, and so can we know. They want to know whether they have a railroad worth what they have it capitalized for. We want to know the same thing. They have to take an account of stock, just as we do. They know just what the value of their railroad is, and it is not the earning capacity in that sense. We are so particular in our company in Camden, that we have everything in that direction go to expense. If we find, by an account of stock, that the values of what we have on hand are not what we are capitalized for, the board takes action and charges it to expense, aiming to keep it up all the time to what it is capitalized for.

Mr. Lockwood: I am interested in this subject, because about a year ago, I asked Mr. De Camp, of Philadelphia, and one or two other members of our Association, for information regarding how they kept their accounts, and in what manner they found just what they were doing, and knew what to count upon as the result of the electric light business. I believe, from what I have heard of Mr. De Camp's method, and what I have heard people read about it to-day, that the plan of going down to the basis per month is the best. The nearer we get to that and the more accurately, the better basis we are getting to work upon.

Now, the point of expense. I believe the nearer we can bring the expense down to the basis per month to compare it, so that we know each month what we do, and not have to wait until the first of January, or whatever date we take our inventory. I believe the nearer we do that, the better we will be informed and the better we can carry out the improvements suggested by the results. I had this case in a company with which I was connected. We found just what the major part of our accounts was per month, such as coal and labor and accounts of that character, and we charged this into the total running expenses for that month. Then we found that the interest and taxes and accounts of that description, repairs included, varied very greatly. The interest and taxes, it is true, we had to pay only once a year, but the repairs we studied over and arrived at this solution: We created what you might call a balancing sheet, and we estimated at the beginning of the year, how much we would likely have to charge up during the year for taxes, insurance and accounts of that description, and then we started in and charged up each

month in our monthly sheet, what we thought was the porportion that that month would have to the total year. If we did not pay our taxes until the ninth month in the year, there was accumulating upon this balancing sheet during those nine months, certain amounts, and we credited the same amounts in the monthly sheet as in the balancing sheet, and then taking the proportionate amount of that nine months, we charged up the proper proportion in the remaining month. We adopted the same system for repairs. Instead of charging up each month just what the repairs were, we estimated as near as possible what they would amount to in each year, and then charged up one-twelfth of the amount we had estimated for the year, and as the end of the year drew near, we could see what to credit or debit on our balancing sheet was going to throw us out of our estimate, and if it was we divided it amongst the remaining months, and charged it up proportionately to each month in the year. I believe that in this way we will better know how to make improvements from our investigations.

One point spoken of is how to charge up inside wiring. We did it this way, and we may be right or wrong: We determined to charge consumers for their inside wiring at a fixed price, unless the amount of wiring was very largely out of the usual course. We put it up for five dollars a lamp, and though it may cost us $10, we charge that up, and if there is a loss, it goes to profit and loss, and if there is a profit, we make the proper entry of it. Then it can be carried as a merchandise account, and I think that is a very fair way of doing it. As to repairs, I think the right way is to keep your station in every respect up to the highest standard. If you simply make up for what is depreciated by wear and tear, I believe every cent of that should go into the running expenses and be divided up on the system of the balancing sheet, and distribute it through the different months of the year.

There being no further discussion of the above topic, the paper and discussion upon it were ordered spread upon the Minutes of the Association.

Mr. Phelps, of New York, read the following telegram:

NEW YORK, February 13, 1890.

To Mr. George M. Phelps, Coates' House.

Just returned from Richmond, where bill for restriction of voltage in Vir-

ginia, has been reported adversely by unanimous vote of Senate Committee, after two days' argument. It was supported by Edison, in person, and the electrical executioner; opposed by Westinghouse. Representatives aided most efficiently by local companies at Norfolk, Alexandria, Petersburg, Fredericksburg, Richmond, Liberty and others. (Signed) R. W. POPE.

The reading of the telegram elicited a hearty outburst of applause.

Mr. M. D. Law, of Philadelphia, presented the following paper:

NINE YEARS WITH THE ARC LAMP.

BY MR. M. D. LAW, OF PHILADELPHIA.

In being honored with an invitation to read a second paper before The National Electric Light Association, I cannot help but feel that there were points of interest to some of you in my other paper presented at the Niagara Falls Convention. The subject of this paper is one that is of interest not only to every central station man, but also to those who handle arc lights in isolated plants; and if I can give you but one point that is of value, I shall feel amply repaid for my labor. There are a large number of irregularities in arc lamps that can be remedied by a judicious study of their actions, and, after the cause of their trouble has been found, it should be remedied, even if the lamp has to be rebuilt.

In order to find the special trouble that arc lamps are subject to, a careful record should be kept of each and every lamp. To do this, give each lamp its individual number, which should be firmly attached to the lamp box and never removed. then by the use of a numbered book, allowing a page for each lamp, a record may be kept of all lamps, where they are, when changed, with the kind and amount of repairs.

This method of keeping a lamp record allows of finding the peculiar trouble that the lamp is subject to, and the remedy can then be applied, preventing any further trouble until the washers, clutches, rods or bushings, have to be removed. If a lamp is continually being changed for the same cause, there is some one thing that is radically wrong, which is causing the trouble, this should be found and rectified; for instance, a lamp may work perfectly on the test rack, but, after being in use for a short time, would have to be changed for dropping. If from the records of that lamp this is found to be its general complaint, then look for the trouble, if a Brush lamp in the winding—that is, there may not be the proper resistance of wire on the magnets, or there is too great a difference in resistance between them, which should not be more than one ohm or the result is a side puller.

The resistance of the magnets should be kept as near as possible to 85 ohms; never allow more than three ohms variation from that amount.

Binding of the mechanism, large washers, or too high adjustment of the arc, will cause dropping; in hunting for the cause of this trouble in the Brush lamp, I found that, with proper construction, it could be made to work

without dash pot or spring, better than the old style with dash pot and spring.

I assume that in a differential magnet there must be a point of equilibrium between the two magnetisms, and that, if the cores were accurately suspended at the center of this point, any veration of current would affect the core quicker if so suspended than if it was forced to or from that point by a spring; this I have found to be the fact. Then by making the lamps so that the core could be adjusted to or from the center of magnetism and get the proper separation of the carbons at that point, would effectually prevent dropping of the carbon rods; and after a Brush lamp is once adjusted in this manner, it will not get out of adjustment until the washers are worn too large. This can be done without glycerine being used in the rods, which is a great source of trouble.

Another point wherein expense is saved in the Brush lamp is in the winding of the cut-out magnet.

Divide the magnet in two parts by an extra fibre head, and then by winding the fine wire at the top, with a resistance of 15 ohms, and the coarse wire can then be wound on at the bottom, allowing the end to make connection with the cut-out armature at least one-half an inch from the head of the magnet, this will reduce the chances of burning out, if there is a bad contact when the lamp cuts out, even if it does burn out, only one wire will have to be removed.

If the following rules are strictly adhered to in the putting together of a Brush lamp, it will be found to burn correctly with but little adjusting:

See that the device carrying the lower carbon holder is parallel with the side rods; also that the screws, etc., at its base work freely, and allow it sufficient lateral motion in all directions to affect the adjustment for which this device is provided.

See that the lower carbon holder is in line with its support, or the carbons will not center.

See that the brass tube carrying the upper carbon holder is straight, smooth, and free from small or flat places, and that it moves freely in its bushings, which should not be too loose, as this will allow the carbon too much lateral motion, and liabie to slip past or wedge.

See that the upper carbon holder is in line with the rod.

This last adjustment is very important, and is made by clamping a steel rod of the same size as the carbons to be used in the holder, and revolving it between the thumb and the finger, noting whether the lower end of the testing rod revolves on its own axis or "wabbles"; in the latter case, push the holder up to the lamp box, and, by means of the testing rod, bend it slightly in the proper direction to correct the error, then see that the carbon holder has not become loosened; test again, repeating the process until the desired adjustment is reached.

Examine the lifting washers which surround the carbon rod, see that the hole is counter sunk on each side, so as to make the available thickness of the washer where it touches the rod but little more than a sixteenth of an

inch. See that the hole in the washer is of such a size that one side of the washer may be raised one-sixteenth of an inch from the horizontal floor on which it rests, before it clamps and commences to lift the rod. See that the holes in the washer and bushings are nicely polished. The lifting finger, designed to lift the washer, should move freely in its guide and get a good hold under the edge of the washer, and allow the latter to rest flat on the floor under it when the finger is down. In the case of double lamps, the lifting finger should be so adjusted as to lift the second rod one-sixteenth of an inch ahead of the first.

See that the movable brass parts connecting the lifting finger with the movable magnet cores work freely at their joints, so that no binding of the parts may be possible.

The spring which partly supports the magnet cores should be made of steel "pianoforte wire," twenty-seven-thousandths of an inch in diameter, wound closely over a mandril of such size, that the spring when released shall have an external diameter of seven-sixteenths of an inch, and shall consist of about 38 turns of wire, exclusive of the hooks at the ends.

See that all the parts of the dash pot are free and do not bind. See that the armature of the cut-out moves freely on its pivot; and when it is down its end is about one-quarter of an inch from the core of the cut-out magnet, and when it is raised and makes contact with the copper wire projecting from the cut-out magnet, that its end comes about three-thirty-seconds of an inch from the cut-out magnet core.

The brass spiral leading from the cut-out armature is not used as a spring, but as a resistance. It must be pulled out or pushed together as the case may require, that it shall exert neither a lifting nor depressing influence on the armature.

This spiral is made of brass wire twenty-nine-thousandths of an inch in diameter and about 30 inches long before being coiled. The size of this wire is important, as it should be of just the right resistance, that the lamps may cut in when the carbons come together, for this same reason the armature is not allowed to come close to the core of the magnet, but should be made to come as close as possible that a better contact may be made, thus reducing the liability of burning out.

The principal improvements that can be made in the Thomson-Houston lamp are, the making of the clutch of German silver or some more durable metal than brass, as the bearing point of the clutch against the rod is so small that it very soon wears and thus throws the lamp out of adjustment. When one of these lamps is found dropping, it can very often be remedied by lowering the adjusting nut No. 692 a trifle, when the lamp will again burn correctly, and, in some cases, this may be repeated several times without any other change in the lamp.

Another great point of improvement in this lamp is, increasing the thickness of the insulations, which are too small in nearly every case, especially is this the case with those under the binding hooks at the top of the lamp box, which I find work excellently well made of porcelain.

When the insulator in part No. 701 gives out, the current shunts through the cut-out magnet, causing what the men term "cut-out armature magnetized," this is a very important point which produces flaming and dropping.

The general causes of the T.-H. lamps dropping are numerous, but if all the working points move freely and without lost motion, it will reduce the number to the few following points: Badly worn spots in the carbon rods, this is a common fault of all arc lamps. The clutch or lifting spring may have lost their temper—these should be made of bright instead of black steel. Clutch arm bent. Clutch or carbon rod bushings may become worn. The adjustment nut No. 692 may be too high, the clutch or tension spring may be too tight. Crooked frames, bent rods or rods striking the chimney, tight bushings, fine wire broken, dirty rods, or the adjustment nut No. 692 being too low, brush in the bushing may be too tight or become corroded or burned, and the magnetizing of the armature before spoken of will cause the lamp to flame and drop.

With the United States or Weston lamp the principal cause of trouble is the tripping from first to second set, and when this happens so that the second set burns first, it generally means a new set of contact springs and new magnets if the lamp burns entirely out of carbons; some of the causes for tripping are, rod sticks or wants new contact brush, lever hook loose, rod scrapes chimney on first set or too much hook on first set, adjusting screw on long hook set too high, lost motion in rocker shaft.

Causes of long arc are, platinum collar dirty or worn out, trip lever sticking or too loose, carbons not burning in proper proportion, burning holder before the carbon rod is down far enough to make contact with trip, small hook dirty, rod crooked near the top, weak magnet, fine wire burnt, clutch holder or armature sticks, rod a little thick at the top and brush too tight.

Causes for dropping out are, weak magnet either fine or coarse, lost motion in rocker, stiff clutch, too much clutch, not enough clutch, slight nigger in coarse wire, plunger too stiff or too loose, plunger bent, broken or crooked plunger rod, bad carbons, which may on starting become soldered together and cannot lift.

The globe holder or carbon holder of the arc lamp is a very much neglected part—that is, the insulations are not made heavy enough, but that the carbon dust or copper droppings falling over the insulations will give sufficient leak that a person standing on the ground and touching the bottom of the lamp may receive a very bad shock, this insulation should be made heavy and so placed that the carbon dust may not fall on it, as it is sometimes impossible to hang lamps under awnings high enough but that, when a person passes under them, they may be touched by any conductor which they may have in their hands. No part of the lamp outside of the globe should be allowed to have current in it. Arc lamps should be suspended by some perfect insulator, the regular porcelain insulator and hook being the best in our experience; this is a very important point and is often neglected, lamps being hung from an ordinary screw eye by a piece of wire are frequently seen, when it is as important that the lamp should be as well insulated as the balance of

the circuit. Dirt must not be allowed to accumulate on any part of the lamp. Rods, switches, bases and globes should be kept well cleaned, and all binding screws kept tight, the rods should be kept thoroughly well wiped every day with a clean cloth or waste; never allow crocus or emery to be used, as it badly wears the rods in the center, a better plan is if the rods become rough or dirty bring the lamp in and polish on the buffing-wheel, which will allow of its being kept of an even size its entire length. A properly tended lamp will need but little adjusting, but when it is required, a regular appointed man should attend to it, or the lamp returned to the station for repairs.

The longest record for any one lamp in a constant street service is three years and nine months without any adjustment other than the ordinary cleaning by the trimmer.

In order to get a good lamp record, no lamp should leave the test rack until it is perfect in all parts.

The most vexatious part of the arc lamp is the globe, it swells the item of expense in spite of the utmost care, besides being a great source of complaint, for I never knew one to be well enough cleaned, but there would be a complaint that it was not polished. The fused copper dropping and burning onto the glass makes them look dirty in spite of the best cleaning.

I have found, after a careful experiment, that it pays to put wire nets (which should be made of copper) on all globes, even for street lighting; having them covered with wire nets prevents pieces from falling out even after they are badly cracked, and if the globe entirely gives way, the net will prevent its falling on some one's head.

Undue heat after the carbon has burned close to the holder is one of the greatest causes for broken globes. This can be partially overcome by leaving the globe about one and one-half inches from the carbon holder.

In looking over the reports of former meetings of this Convention, it is easy to see that nearly all of the discussions have been on how to save coal. Of course, this is a point where large money may be saved by use of proper boilers and settings, but the best of these will do no good without proper firing.

There are many other points in the management of an electric light station which are just as important, the most serious of these is the pay roll, as two men more than is necessary will cost nearly as much as a ton of coal per day, and 30 tons of coal per month would be quite a saving, and yet while keeping the number of men as low as possible, none but first-class men should be employed, that all work may be done in a first-class substantial manner. Especially must trimmers attend to their duty well, as the quality of their work dictates the amount of rebates to be allowed during the month. Another important man in this respect is the dynamo man. He should give the dynamos the most assiduous attention, that the strength of the current may be kept constant, while flashings and interruptions of the current may be reduced to a minimum, for no matter how well every other department of a station is carried on, if the current is allowed to vary from the standard, complaints will follow, and they are expensive.

There is nothing that angers a user of electric lights so much as to have them flash; it may be only one or two seconds that they are out, but it always seems like a much longer time, especially if in a crowded hall. Rather have the record for continuity of lights so good that even the gas fixtures may be removed; this can only be gained by close attention to the machines, wires and lamps.

I call to mind one place that we have lighted continuously, without any other method of illumination than arc lamps, for over eight years, and during that time the lights have never been out during lighting hours.

The waste in the use of carbons is a very important feature. These should be dealt out and every stump returned; the amount saved in laying by the four and five inch stumps to be used in the Summer months will make a saving of at least 10,000 carbons per year for a 1,000-light station.

At the time I first started dealing out carbons and bringing in stumps, I saved on an average over $30 per month, and then only trimming about 400 lamps per day.

A very important feature of arc light stations is the inside wiring and line construction, which is very much neglected; all inside wiring should be of best quality of insulation, and run on glass or porcelain throughout their whole length.

An arc light wire should never be concealed.

The use of soft rubber tubing for passing through floors, ceilings, walls, etc., should never be allowed, the only suitable material for such work is hard rubber tubing.

While I am a great believer in the use of the best quality of insulation for line construction, yet it is not best to depend entirely on such insulation for safety.

Put up the best wire there is, and then apply a rigid system of inspection and tests, not by that abomination of tests, the magneto bell. Not only should the tests be made on dead lines, but should be made at least once in two hours on all live wires, and when grounds or bad leaks are discovered, they should be immediately cleared, by that means preventing the second ground, which is the element of danger.

I have repeatedly had lines that would test clear at the time of putting on circuits, but two hours after, solid grounds have been discovered, located, and found to be wires broken down, hanging over the electric light wires and reaching down to the sidewalk, where they are a source of danger to every passer by; besides, every boy that passes must feel of it to see if there is any electricity in it.

My orders are to drop all work that is not absolutely necessary to clear grounds.

In Philadelphia we receive great help from the Electrical Bureau of the city, by their promptly reporting all wires discovered that are down on us.

All lines should be cut by one man, who is especially instructed and detailed for that work, as then you are enabled to pick out a thoroughly reliable man and drill him in the work that he is to do, then, by never allowing a cir-

cuit to be opened, and teaching all men to never depend on any insulation but to treat all wires and lamps as if they were charged with an electric light current, dangers to employés will be reduced to a minimum.

Supplementing the paper, Mr. Law said: In presenting this paper, I have done so with a view to benefiting, if possible, the central station men. You will find in the paper a few rules for the operation of the Brush, Thomson-Houston and Western arc lamps, which lamps have come directly under my personal supervision. If these rules are strictly followed out in the repairing of those lamps, you will find but little trouble, and but little necessity of putting them on the testing rack. Another point that I would like to call your special attention to, is in the matter of testing arc light lines. It has only been within the last six or eight months that we have been putting a thorough test to line wires. Since the time of the Niagara Convention we have perfected the system which I specified at that time, and I can positively now locate a ground at the station before leaving to hunt it up. Those tests are made at regular intervals of about two hours during the night and day on all live circuits. As soon as those circuits are discovered grounded, my foreman is notified, and I also receive notice myself, and the proper men are detailed to remove those grounds as soon as possible, not allowing them to remain on. There are a number of points in the paper which I have not carried out to completion, but have simply called your attention to them.

In the absence of Mr. E. F. Peck, of Brooklyn, N. Y., his paper on "Carbon Tests" was read by Colonel C. M. Ransom, of Boston.

CARBON TESTS.

BY E. F. PECK.

The first electric light of any consequence was used by Sir Humphrey Davy, in 1810. He had discovered that when the two terminals of a charged electric circuit were separated a short distance, an electric spark would pass between these terminals by evaporizing the material of which the electrodes were composed, and that the vapor thus produced would continue to carry the current between the electrodes, and that these vapors, together with the highly incandescent solid ends of the electrodes, would emit a powerful light. The vaporized material bridging the space between the terminals of the electric circuit he denominated the electric arc, for the reason that these vapors

would pass in a curved path between the two electrodes. Sir Humphrey Davy demonstrated this interesting phenomenon by using a great variety of material for the electrodes, and he found that the most brilliant effects were produced when the electrodes were made of carbons. The carbon used by him was charcoal made from various woods. It was found, however, that the charcoal, from whatever wood it was made, always had a considerable electrical resistance, and was so rapidly consumed that it could not be used for the production of arc lights for practical purposes, such as general illumination. Other electricians took hold of Sir Humphrey Davy's discovery, and their efforts were directed toward the discovery of material for the production of electrodes of greater durability and better conductivity. It was finally discovered that carbon deposited in the neck of gas retorts possessed a high degree of conductivity, and was exceedingly hard, and, therefore, would be very durable when used as electrodes for arc lights. Rods or pencils of this gas retort carbon were made and shaped at great expense and trouble, and they were found to be excellent substitutes for the charcoal electrodes, still these gas retort carbons could never be used on a large scale for the reason that they could be shaped to the required form only at a very great expense, being exceedingly hard. The next step in the improvement of carbon electrodes for arc lamps was made in 1842, when Bunsen invented what he called the "Plastic" carbon as the negative electrode of his battery. This carbon electrode was made of various mixtures of powdered charcoal, molasses, sugar, etc. It could be shaped to any desired form, and was made by Bunsen in the shape of hollow cylinders and flat plates. When it was found that this carbon electrode could be used to advantage for the production of electric arc lights, it was at once substituted for the gas carbon. This substitution was not a universal one, for as late as 1873 and 1874, Professor Tindall was in the habit of using gas retort carbons in the production of electric arc lights, although he complained bitterly to his audiences that the production of his carbon electrodes involved great expense and trouble. The carbons burned at the Centennial Exposition in 1876 were of this material, but we have no data of their life or resistance. They were made by Carré, of France, and the current was from a Gramme machine. From 1843, when Bunsen invented his "Plastic" or moulded carbon, to 1879, many inventors of this country and Europe tried to improve on his discovery. Their chief object was to produce a carbon of greater and more uniform density and of higher conductivity. The English patents were especially numerous during this period, and their mixture in the more enlightened state of the art seems very ludicrous. Though some labored at the problem nearly 15 years, on the whole, no great improvement was made. This poverty of result was largely due to the fact that the dynamo apparatus of the day was unknown. All arc lights were produced by currents generated by batteries. The modern arc lamp, with its simple but effective mechanism, was unknown. The arc light was only a curious laboratory plaything, generated expensively and burned disadvantageously. The proper experimental condition to enable an inventor to produce good carbons did not exist, and the finan-

cial stimulus of commercial demands was wholly absent. The modern arc light carbon of commerce is hardly 10 years old. It became a necessity as soon as the modern dynamo apparatus was completed and commercial lighting by electricity was seen to be coming in the near future. The problem may be said to have been undertaken in 1878. The first point was to discover crude carbon that was both pure and cheap. At the suggestion of Fayette Brown, of Cleveland, Ohio, his son, A. E. Brown, then experimenting for the Brush Electric Company, tried residue from petroleum. Careful experiment proved this to be the long-sought-for crude material, nor have the investigations of the past 10 years found any better. The next point was to manufacture carbons of the requisite quality. Nearly three years later the Brush carbon was produced. The first cost of these was very high, and the demand small. Where carbons are now sold by the 100,000, they were then sold by the dozen. Like most new articles, the process of manufacture was round-about and tedious; consequently, both the cost and market price of carbons, 10 years ago, was very high, the first carbons selling as high as $125 per 1,000. I cannot learn that any tests were made of these carbons for resistance, brilliancy, or even exact life. In those days manufacturers were well satisfied if they could make carbons that would burn fairly well, and gave other considerations very little thought, because they were relatively very unimportant. Besides Mr. Brush and his associates, there were several others, in different parts of the country, working at the carbon business on different lines. At Ansonia, Conn., the Messrs. Wallace were experimenting with forced carbons, with much success, following the process of Carrè, of France. This carbon was very dense and hard, and when sounded gave forth a ring almost like a bell. Not to mention many others, Mr. Thompson, of Newark, N. J., was also in the field, but clinging to gas retort carbons for his crude material, did not meet with the success achieved by his competitors. Since those early days of experimental work, manufacturers have paid special attention to reducing the cost, lowering the resistance, and increasing the brilliancy and life of the carbon. Early in the Spring of 1889, at the suggestion of a representative of one of the large carbon manufacturers, I decided to base a year's contract for carbons on the comparative test of the best known carbons in the market. I made two or three tests, taking into consideration simply the life and resistance of the carbons as adapted to the system of lighting we were using. The tests were rather crude, and not made for the purpose of booming any particular carbon, but to satisfy myself as to what carbon I could best afford to burn. The final test was made with a group of Thomson-Houston lamps on a six and one-half ampere circuit. Two sets of carbons of each make were placed in the lamps and each lamp adjusted to the lowest point at which a quiet arc could be maintained. A record was made of the time of starting each lamp and they were then allowed to burn until all the lamps had cut themselves out, automatically, by the burning out of the carbons. The electromotive force at the terminals of each lamp was then recorded at intervals of half an

hour through the day. The result of the test, stated briefly, was as follows:

Lamps,	1 and 2	3 and 4	5 and 6	7 and 8	9 and 10	11 and 12
Average E. M. F.,	42.23	42.73	47.16	48.37	47.76	49.66
Average inches burned per hour,	1.23	1.46	1.44	1.57	1.72	1.69

As will be seen by this table, there was a difference of 7.43 volts, or a saving of about 15 per cent. in the electromotive force of the best over the poorest carbon tested, and a difference in life of .49 inches per hour, or a saving of 29 per cent. In a station burning 1,000 arc lamps, this means a saving of 64.73 electrical horse-power, without considering the saving in carbons. The figures given above show very plainly the importance of such tests, and I would recommend that superintendents and managers of central lighting stations give this matter their consideration before adopting any special make of carbons.

THE PRESIDENT: Gentlemen, the subject is now before you for general discussion. I shall be pleased to hear from any of the delegates on this matter. It is a matter of great importance.

MR. FRANCISCO: If it is not a secret of the business, I would like to ask Mr. Law with what instrument he tests grounds at the stations?

MR. LAW: I do not know that there is anything about our station that we call private. We are always glad to give any information we can. The manner in which I have been testing grounds at our station for the past year or 18 months is by the use of a set of incandescent lamps in series; that is, I use 47-volt lamps for a 60-light machine. Those lamps are put up out of the way, and a wire run from each one of those lamps to the switch plate. There is a lever to turn around in a circle, making a short circuit of one, two, three, four, five, etc., to cut out one or all of those lamps. Now, if a wire drops down on an electric wire, grounding it, the distance which that wire is away from the station is simply a measure of potentials. Every two hours we test each one of our circuits in the first place by testing across the circuit. The number of incandescent lamps then burning up to 48 volts indicates the number of lamps that are actually burning on the circuit, less the resistance of line, which I find amounts to about ten miles of No. 4 wire for every arc lamp; then we test by placing one side of the incandescent circuit to ground and the other side to line; then, by turning off my incandescent lights until I bring the voltage up to 47, I find a cer-

tain number of lamps burning. We will say 10 lamps on the positive side. Now, I turn my attention to the negative side and go through the same operation. If I find that I have 50 lamps on the negative side, I know that the ground is 10 arc lamps away from the station on the positive side, and if your circuit books and diagram books are correctly kept, you can tell within two or three moments' time exactly the location of that lamp. In 99 times out of 100 we go to the right lamp.

MR. J. E. LOCKWOOD: I think this is a subject that deserves a great deal of attention, and that more would be done to prevent damage to electrical interests by false representations of the press, by giving them no foundation for any report than by any other means that we have at our disposal. I will not take the time of the Convention now to speak on this subject, as I have a paper that I shall read to the Convention to-morrow morning. While I think the Law system is a very good one, I think we have now at command one which is much better.

THE PRESIDENT: Is there any further discussion of this subject? We would like very much to hear the central station men give freely of their experience. With the usual instructions to the Secretary, there appearing to be no further discussion, we will pass this topic.

MR. DE CAMP: I would like to ask a question. In Mr. Peck's paper he speaks of an arc lamp being burned at the Centennial in 1876. I will ask if any gentleman present saw that light? I was at the Centennial probably a hundred times, and never saw it. I would like to find the fellow that did.

SECRETARY GARRATT: I did not see the lamp at the Centennial, but as a matter of early history in regard to the arc light industry in this country, I did see an arc lamp run in Boston in 1865; that, however, was not to be called commercial, in the sense in which you use it to-day. It was an arc lamp with clock-work feed, operated by a Grove battery.

MR. LOCKWOOD: While I did not see any lamp at the Centennial, I will state that Mr. Frank B. Ray, of Detroit, will give the gentleman the information he wants. My reason for thinking so, is that Mr. Ray gave me not long ago an account of an interesting experiment he made at the Centennial. He found that, by making a flat helix of fine wire and connecting it with the

receiver of a telephone, that he could approach a dynamo, and before he got within, say, five or six feet and sometimes 15 or 20, by holding it out ahead of him, and moving it through the air, he would get induction, and then by comparing that with the tones of a flute that he had, that had been attuned to respond to a certain number of vibrations, he could tell the number of revolutions the dynamo was making, multiplied by the commutator sections. (Laughter.)

MR. DE CAMP: That reminds me of a story of a man who went out West, and found a very desirable site on which to settle, but he took the precaution to ask the man who was selling the place, if there was any chills and fever there. He said, no, but there is in the next county. He went to the next county and asked the same question, and they said the same thing. I have asked a hundred times about this lamp at the Centennial, and never saw the man that saw it.

MR. F. S. TERRY (of Chicago): I will say that I saw that lamp in Philadelphia.

THE PRESIDENT: The next order of business is, "How our Paths may be made Paths of Peace," by Mr. Pope, of Elizabeth, N. J. This paper has been distributed to the members of the Convention, and having been read by title, is now before you for discussion. There being no discussion on this paper, it will be passed.

The paper presented by Mr. Pope, is as follows:

HOW OUR PATHS MAY BE MADE PATHS OF PEACE.

BY H. W. POPE, OF ELIZABETH, N. J.

Previous to the introduction of the telephone, the standard of out-door or pole line construction may be said to have been that established by the Western Union Telegraph Company, or organizations that from time to time came under its control by purchase or consolidation. The lines of these companies were never of a superior character, nor in any way comparable at the time with those erected in European countries, and it was not until after thorough inspection and exhaustive tests were made by a prominent English electrician, employed for the purpose, that extensive alterations and improvements were made, greatly increasing the efficiency of the wires, and, naturally, their more economical operation.

The construction of a most excellent line along the route of the Pennsylvania Railroad, between Jersey City and Philadelphia, by the management of the American Union Telegraph Company, previous to the absorption of

that company, marked a new era in line construction, but, notwithstanding the brain that inaugurated this departure afterward controlled the great competing company, the standard thus established was never closely followed by them.

However parsimonious the Western Union Company may have been in their construction and maintenance expenditures, telephone, electric light and similar corporations would have been greatly enriched by literally following in their footsteps. They encouraged and provided for increased conductivity and tensile strength and fair insulation, and established a department of competent and reputable electricians and experts, to insure a systematic compliance with specifications and requirements, destroying the evil that had grown into prominence, which permitted officials to exploit hobbies of their own to the detriment of the business and the ridicule of electricians. To those of us who have been identified with electrical interests for the last quarter of a century, there seems to have been no notable improvement in line construction, except as shown in the recent interstate lines of the American Telephone & Telegraph Company. The introduction of the telephone brought into the electrical field a very large class of workers devoid of electrical knowledge or experience. To this class, the methods employed and the standard of construction prevalent, were superior to the necessity and requirements of the telephone. This opinion and the lack of sufficient capital to properly exploit the telephone business was primarily the cause of the introduction of poor material and workmanship, as well as the small wire and insulators, together with porcelain knobs and cheap insulation.

With the experience of our predecessors in the electrical field, and with the knowledge of the character of the current we were handling, it would seem as if a superior character of construction and insulation would have been deemed imperative; yet, with the exception, perhaps, of conductivity, everything in connection with the conducting of the current was inferior to that previously used by corporations employing harmless voltage. That such was the case, is due somewhat to causes similar to the introduction of the telephone; but the use of cheap insulation, what is popularly and properly known as "undertakers'" wire; was due wholly to the ignorance and stupidity of underwriters' officials, to whom many of us protested repeatedly against its use.

The accumulation of poles, the inferior character of the materials used, and the utter disregard of public considerations or the character and beauty of the surroundings, gradually moulded public opinion against poles and wires in general, and electric lighting in particular.

The desire of electrical manufacturers to crush their competitors was accelerated by distressing accidents, until every publication throughout the land magnified the dangers of electricity, depreciated our property and retarded the progress of electric lighting and electric propulsion beyond our comprehension. To this condition of things we must now devote our attention. Adverse legislation is cropping out in nearly every State in the Union, tending to regulate voltage, to bury the wires, and to accomplish other

reforms too numerous to mention. In view of all this, it should be the aim of electric lighting corporations to so reform the existing methods of construction as to show a decent regard for public opinion as to safety and the appearance of their structures in the public thoroughfares. By a sincere effort in this respect, beneficial improvements can be introduced without necessitating large expenditures, and the clamor for the removal of overhead wires reduced to a minimum. Where there happens to be an unnecessary aggregation of poles, endeavor to perfect an arrangement whereby poles may be occupied in unison, and as many poles removed as circumstances will admit. Such a course will reduce your maintenance expenses, and create for you favorable public opinion. In the erection of poles, considerable attention should be devoted to their design and proportions, and the character of finish, to the end that the structure may be made pleasing to the eye. The removal of a pole because of deterioration, or with a view to the erection of another with greater capacity, should be followed by the substitution of one in every respect superior in strength, design and finish. The question of expense, as compared with common poles, should not be allowed to deter you from the ultimate purpose of replacing your entire line, especially in cities or towns where the burial of wires would be a financial impossibility.

To those familiar with the recent excellent structures of the Long Distance Telephone Company, or those of some of the electric railways, the possibility of improving upon the present methods of construction will readily suggest itself. While it is not advisable to use iron poles, combination of wood and iron can be used to advantage in many instances. The practice of introducing wires into the front of buildings is an objectionable method and should be discouraged when possible. This can often be obviated, as well as hundreds of other similar disreputable and unsightly practices, if given a little personal attention and consideration by the general manager.

It will be frequently discovered upon investigation, that lines of poles erected in the streets in front of buildings can be removed to an alley or street in the rear, or constructed over private rights of way by the payment of a nominal consideration. Where such a condition of things is possible, it will be found desirable and preferable to incur the expense and make the change voluntarily.

Reduce, rather than augment, the number of poles which at the best cannot be else than unsightly. Provide every pole with iron steps and paint the poles as thoroughly as you would a house, and select colors that will not make your poles more conspicuous than they really are.

In so far as a neat, well-designed and substantial brick station, reduces your rate of insurance, gives character and substantiability to your investment, so will the improvements suggested—however small and insignificant at first—if properly and sincerely carried out, win for you favorable consideration and fair treatment, and enhance materially the value of your property, besides tending to postpone indefinitely the removal of overhead wires.

It should be the aim and policy of all electrical corporations to constantly improve the condition of poles and lines—giving as much attention to their strength and beauty as to their perfection electrically. The assumption that such a course is unwise, because of the theory that sooner or later all wires must be buried, is wrong, because it is questionable whether such an extreme will be reached, especially in cities and towns of small population.

Every day that you delay these improvements you encourage adverse criticism and hasten adverse legislation, State and municipal.

Subways and underground structures are not pleasant things for the strongest of us to contemplate, and where, heretofore, you have had only the gas interest to advocate these measures, you now have competitors in the electric light business, urging legislation against overhead wires with the same earnestness as inventors and manufacturers of cables and subway appliances. These interests are better equipped with facts and figures than has been the case heretofore.

A policy such as outlined, and a vigorous State organization of electric lighting companies, will protect our interests from any severe measures at the hands of the general public.

THE PRESIDENT: The next order of business will be a paper by Professor Elihu Thomson, on "Safety and Safety Devices in Electric Installations." The paper has been distributed to the delegates and the discussion upon it will be opened by Mr. Lockwood, of Detroit.

The paper of Professor Thomson was as follows:

SAFETY AND SAFETY DEVICES IN ELECTRIC INSTALLATIONS.

BY PROF. ELIHU THOMSON, OF LYNN, MASS.

The development of the electrical arts, particularly in the direction of lighting and motive power transmission, has, in the past few years, been very great. It has brought with it a demand for very much work of a novel character, as regards the details of plant and methods of installation. It has also entailed, in many cases, elements of risk to life and danger of fire. How far these risks have been or can be removed by proper attention to details and care in installation, has become an important subject for discussion. How far such risks have been increased by reckless installation of conductors, by faulty materials and supervision, it is not easy to determine. There can be no doubt, however, that electricity, as an agent, in itself is not to be charged with bringing about the results for which recklessness in its use is sufficient to account. That under favorable conditions for discharge through a person's body, electric currents of comparatively high pressure may injure or kill, is not to be questioned for a moment. I have no sympathy with any effort tending to impress a false estimate of such risks, or tending to give the impression that they are absent, when, in reality, they are existent. I have no sympathy with any efforts to exaggerate such risks, efforts which have not been

wanting, indeed, as is well known. The fire risk, as well as the personal risk, involved in electric work is present in a greater or less degree, in accordance with the perfection of the work of installation and maintenance, the provision of the proper safeguards, and selection of the best conditions.

These are matters which are, every day, of growing importance in all the electric industries, not even excepting telephonic systems and other such work, which, if badly arranged and not properly maintained, may cause crosses due to falling wires, etc., to become sources of danger, trouble and annoyance in the distribution of lighting or other currents. There is one fact which is of the greatest importance in this connection, and it is that safe installation means, also, good service. There can be no question that the risk to life *from shocks*, even with bad work, would be removed by not using high potential currents, as they are called, either alternating or direct. There can be no question, also, that a shock obtained from certain characters of current, such as an alternating current, is much less safe than in the case of continuous currents of equivalent pressures. Nevertheless, I am just as firmly convinced that the fire risk is very much less with alternating than with continuous currents of equivalent potential, assuming the work of installation equally good. The fact that it is difficult to sustain an arc, or rather that it is easy to select conditions which will prevent arcs forming, with the alternating system, as compared with the continuous current systems of much less potential, is greatly in favor of the former. Hence switches, fuses, bad joints, ruptured wires, are much less liable to arc and incur risk of fire with alternating than with continuous currents. Would it be possible to work successfully, using only low potential currents of either character? Would we be able to utilize water powers for lighting, without employing pressure of potential sufficient to convey the energy to a distance over a conductor of moderate or non-prohibitive cost? In most cases, we would certainly not be so able. Again, to utilize water frontage for cheap coal supply, and to employ compound condensing engines, to ensure small running expenses by massing the machinery at one station, to make use of railroad facilities, etc., in short, to work under the most advantageous operative and economical conditions, we *must* convey electrical energy by moderately high electric pressures, so as to avoid prohibitive losses or prohibitive cost of conducting wires. If ever our great natural resources in water powers are to be developed and utilized, it will be by the employment of comparatively great electrical pressures for conveyance of energy to distant points. If great saving of cost of fuel and other expenses in operating one large steam plant, instead of a number of separate plants, with their attendant risks, in large cities, is an object worth seeking, it will be found in the conveyance of electric energy at fairly high pressures. It must not be forgotten in this connection that even with very low pressure currents, safety from fire risk is only to be secured by careful construction and supervision, and that risk of fire often involves personal risk. Subway and underground conductors have caused manhole explosions, with both low and high potential currents. Such accidents are generally explained by accumulations of coal gas formed in the manhole and subse-

quently fired by the electric arc or spark of a leak. This may be and probably is sufficient explanation, but another may be given—the evidence of the possible correctness of which I have witnesssed. A heavy leak or overheating occurring at some point of the conductors near the manhole, may generate directly a large volume of inflammable gas from the distillation of asphaltum or other substance used as an insulator, and this gas, mixing with the air of the manhole, may be easily fired by the heat of an arc or spark subsequently to its production, and cause a violent explosion. The remedy is thorough and continuous ventilation of the spaces in the manhole and subway. An instance of a storage battery car being wrecked from a similar cause, is on record. In this case the battery conductors were probably overheated by a short circuit and filled the compartment in which the batteries were with inflammable gases, and the further heating fired the mixture, the result being a violent explosion which greatly damaged the car. Such accidents always involve personal risks, and are to be prevented by simple means properly applied.

But the popular mind is so used to gas explosions that the newspapers have only a few lines to devote to them, while an accident in which an electric shock is obtained, although it has taken place through disregard of some simple precaution, is more than likely to be copiously provided with head lines and harrowing details. I even find one of the journals, whose name states its scientific character, attributing both the Lynn and Boston fires to electric wires. There is on exhibition at Lynn, as a curiosity, the oil stove which caused the fire, and inquiry into the cause of the Boston fire has, so far as I can learn, rather tended to discredit the theory than to confirm it. Notwithstanding these facts, it is true that under faulty conditions of lines or plant, fires may arise, and hitherto have arisen, traceable directly to the heating effects of electric currents. Perhaps if the accidents which happen serve to enforce the fact that the best work, the most thorough provision for emergencies and careful consideration of details of electric work, will be requisite to secure proper safety in the electrical field as in other classes of work, their mission will be fulfilled. Severe and inconsiderate as has been the dealing with the wire question by the authorities in New York City, yet it cannot be denied that the condition of the overhead circuits there had been, in the past few years, going from very bad to much worse. In many cases considerations of safe working would seem to have been neglected in the competition for business. The lines of four or five different companies competing in the same territory might be found, the result of this condition being, without doubt, to enormously increase the risks. There have been hints of the coupling up of dynamos in series, and so increasing the potential of lines already worked at too high pressures in relation to their condition of insulation, and to the placing of the lamps or other work supplied from such lines. Along with this we find the air full of telephone, telegraph and signal wires, of various sorts, none too secure from rusting out or breaking. Many of these latter wires could, no doubt, be easily buried underground, with advantage to

the service, but it is certain that to attempt to bury the electric light wires in a hasty, ill-considered fashion, merely for the sake of getting rid of overhead lines, would be productive of no good results, either in avoiding risks or bettering the service. The placing underground of very many of the wires now found overhead in our large cities is, in my opinion, a matter which must come in time, but it should be done carefully and gradually, so as to secure the best work. Meanwhile the re-organization of existing wires, the removal of inused wires or redundant wires, as where two systems or circuits in the same territory overlap while serving substantially the same purpose of supply, and the use of first-class insulation on the wires, would go far to securing safe working and uniformly good service. Besides all these precautions, and outside of them, wherever the conditions are and have been favorable to safe installation of overhead or underground circuits, there are to be found a class of appliances which are called "Safety Devices," inasmuch as it is their purpose to provide for abnormal conditions and remove risks which, with perfect working and maintenance, are usually absent, but may be brought into existence by accident or unforeseen defects. Such risks may be by outside interference with lines, or by lightning, by falling or poorly constructed signal and other wires upon overhead wires, by unusual wind or sleet storms, by failures of all kinds, as in the working of lamps, switches, etc. It is here that the safety device is found to be useful. Such devices are to the electrical systems what check valves, overflows, traps and safety valves are to hydraulic systems. There is, of course, no room for doubt that if the insulation of all parts of the plant, as dynamos, lines, lamps, etc., were maintained always at its best, and if the mechanical strength of lines, hangers, poles, etc., could be always relied upon, and, further, if the effects of lightning induction were never present, there would be but little use for any purely electrical safety appliances, such as those for guarding against leaks and diversions of current. To expect such perfection of conditions is to expect too much. A rigid system of frequent testing can, however, go far to anticipate and to discover the departures from such safe conditions, and enable the disturbing conditions to be removed. Nevertheless, there will always remain opportunity for unskilled or careless handling so altering the condition as to provoke trouble; there will always remain chances of undiscovered defects, chances of interference from outside. The effects of lightning are an important factor during the thunderstorm season. I am driven to conclude, therefore, that safety devices are, and will continue to be, important factors in electric work. The more thoroughly they are adapted to their intended functions, the greater the security, and the more extended their application. That system of distribution will surely survive, which, while involving economy of first cost and maintenance, at the same time secures the greater safety and embodies the greatest flexibility. I assume, of course, that the running economy is practically good in every case.

In the very early days of arc lighting, with a single lamp only on a circuit, the idea of safety from fire or shock did not present itself. When such lamps began to be run in a series of eight or ten, or more, the need of an

efficient cut-out was felt, so that a defective lamp failing to feed its carbons should not burn with a long arc or flame, and so involve risk of fire, or extinguish the other lights. This need was met, in 1876, by Lontin, who used the shunt circuit to actuate a shunting switch around the defective lamp. The Brush cut-out followed, and was a decided improvement on Lontin. Fuller and others early went over the same ground. The film cut-out, or shunting switch, depending on a small thickness of a high resistance insulator, such as oiled paper, to prevent its closure, which paper film is overcome by the difference of potential or pressure between the carbons when a long arc forms, was brought out by the writer, and later, the "vacuum cut-out," a modification which rendered the device self-setting for repeated action if needed. It is scarcely necessary to add that spark-catchers and enclosing globes with wire nettings, were early additions to arc lamps to prevent sparks reaching inflammable material near by, and the globe also in addition served to diffuse the light. Current regulators were additions to arc machines, and acted to prevent undue current, and secure thereby not only safety, but good service. The fact that good service in most cases is assisted by appliances which ensure the safety, or is even dependent on them, is a fact which ought not to be lost sight of in connection with the general subject of electric installation.

The early installations for arc light in and out of buildings, were made with bare wire circuits, and it is a satisfaction to me to recall in these days of forgetfulness of the benefits conferred by electric industries, and exaggeration of the dangers of properly installed plants, a case which occurred in connection with one of the earliest commercial plants of the Thomson-Houston arc lights, in 1879. The machine of about eight or nine lights capacity, with bare wire lines, was put up in a large brewery in Philadelphia; two arc lights lighting the stables in which were 30, or more, valuable horses. One evening a fire started in the hay-lofts in the story above, and where there were no lights of any kind used, and soon the flame and smoke spread to the stable room and menaced the horses. The proprietor happened to think to start up the electric lights at this juncture. Their brilliant rays saved the animals, which were removed without trouble, and the lights were kept burning during the progress of the fire. Its spread was limited by the efficient work of the fire department. The arc lamp globes were at times full of water, but, to the surprise of the firemen, the lights were not extinguished, but assisted them in ther efforts very materially.

As the number of arc lights placed in a circuit grew, the necessity for thorough insulation was appreciated; the effort to secure which, for arc lighting lines, has resulted in very great improvements being made in the past few years. So far as electric wires go, the best "safety device" is a perfect insulation. In order that this matter shall not assume the condition of a trial of strength between armor and armor-piercing, as in naval affairs, with a constant growth of both, the advantage always being on the side of armor-piercing or insulation-piercing, I think that efforts to run more than a certain limited number of arc lights in series should be discouraged. Eighty

or 100 lights, or even more, have been run and could doubtless be run safely under favorable conditions, but I doubt that such conditions can be found in city work; the interfering actions are too numerous, while the maintenance of good conditions would be too expensive. Without such good conditions, there would be grave dangers involved.

It has become a practice to use incandescent lamps of low resistance in series on arc light circuits or other constant current lines and much useful work is so accomplished. Here, again, safety from fire risk depends on certain safety devices, the most important of which is the shunt-forming device, when the carbon lamp conductor breaks. A number of very simple and effective devices are employed for this shunting action. Without such devices the tendency to arcing would be very great. It is advisable also not to rely on any one device alone for this purpose, especially if the lights are used indoors. Here. the film cut-outs may supplement the action of a shunting device operated by the heat of an arc set up when the lamp carbon becomes discontinuous. These latter are the fusing cut-outs, twisted wire cut-outs, and others which connect the lamp wires together in the lamp, and so form a complete shunt. Other forms exist, notably the third wire cut-out, acting by diversion of current from the arc to a third or intermediate wire between the lamp conductors.

As in the case of the other devices mentioned, the perfection of operation of one, or a combination of several of these shunting contrivances, conduces not only to uniform service but to absence of risk. Absolute cut-off switches are now in common, if not in universal, use to cut-out loops of series circuits, and in a measure may, therefore, be regarded as safety devices, but not of an automatic character. Outside of these factors just mentioned, safety in such circuits rests in insulation and maintenance, avoidance of leaks or crosses, proper placing of wires and lamps, avoidance of partial contacts or partial ruptures of the circuit at joints, binding posts or switches. In series circuits, the main object is to avoid a concentration of, or establishment of, large differences of potential at points in the line where the current finds or can find a path; in low potential multiple arc systems, as used in direct incandescent work, the object is to avoid concentration of current at points where such current cannot find a sufficiently low resistance path. Hence, there is required cut-offs for current when excessive in any part of the system. Short-circuits of accidental character must be provided against. If the safeguards are not ample, a more potent fire producer than a short-circuited section of an extended multiple arc system, is hard to find. Take out your fuse wires and replace them with copper wires, a practice, instances of which were not difficult to find in times past, and a short-circuit may quickly heat a long line of wire in a building, so as to set fire to the insulation of the wire and surrounding woodwork. The fusible wire cut-out, if properly made and used, is an effective preventative of such risks, though magnetic cut-offs are preferred by some, though more expensive. The magnetic cut-offs, which are simply open-circuiting switches, controlled by magnets in the branch or line so as to open it on excessive current, have the advantages of promptness, avoidance

of the scattering about of fused metal, and can be reset without any renewal of material, so differing from the case of a fuse wire. Another risk in such systems is that of creeping of current from main to main over moist surfaces or partial conductors, in amount insufficient to blow a fuse, but sufficient to convert enough energy into heat to set afire. Good waterproof insulation of wires avoids this risk if the insulation remains intact. I consider the plan of running the two branch wires, excepting the larger ones of the system, near together or close together, as excellent in avoiding this risk, provided the wires are encased in insulation and covered in, or run in a tube. In case of a leak from main to main, the more quickly the fuses blow, the better, and the proximity of the wires assists this speedy action, while between the wires there is not at any time enough combustible matter to set afire by the short-circuit. Enclosure in a tube effectually shuts off possibility of flame reaching combustible matter before the fuse blows. This does not apply to the heavier mains, capable of carrying thousands of amperes, so well as it does to the smaller branches. I am glad to note here that the tube or conduit system appears to be well worked out for inside wiring by the Interior Electrical Conduit Company.

Another thing to be avoided in extended systems of multiple arc work is grounding or leakage to ground of current over resisting surfaces or materials. The tube system is useful here as well, and the placing of two wires at difference of potential, near together, assists somewhat, but does not entirely remove liability of grounding. Testing for grounds in the system, taken in sections, is the proper procedure, although this does not provide against all suddenly formed leaks. It may be argued that in this case two grounds are necessary to cause a leak, one on each side of the system, and this is true, but in very extended systems of overhead work, more or less general leak exists which may provide sufficient current to feed, as it were, a local leak to ground from either main.

Let us now deal with what is called the alternating or induction system of supply, in which the local, or house mains, are separate from the primary mains, and of much lower potential. For lighting purposes the system is very flexible, and enables distance to be overcome. The secondary circuit is, or should be, entirely out of connection with the primary mains of high potential, and the potential differences of the secondary circuit may be so low as to be incapable of giving a severe shock under the conditions of use, and to be almost incapable of setting afire, on account of the absence of arc forming tendencies. This is, indeed, an important factor in alternating current work, and conduces to the perfect working of switches and cut-outs, and the prevention of diversion to ground. Good work is all that is needed in this case to abolish all risks, if we leave out the main high potential current. The local line is unaffected by leaks or grounds at other parts of the system, and is, therefore, in this respect, in a better condition than is found with the consumer's lines in any direct system of supply. On the other hand, all the cases in which persons have received a shock from an alternating current of 1,000 volts or upwards, without being killed, are fortunate accidents,

for there cannot be the slightest doubt that such current can and will kill under conditions favorable to its passage through the body. There are many cases of severe shocks having been obtained from such currents without permanent injury. On the other hand, there is a sufficient number of fatalities on record to sustain the position taken. The risks with higher than 1,000 volts alternating current are, of course, greater. It must not be forgotten, in this connection, that the actual potential differences in an alternating current of 1,000 volts are higher than that figure, and may be, at every wave, upwards of twice as much. This confers on such currents an actual and measurable striking distance between the two mains. As with arc lighting lines, the main or primary wires, if overhead, requires to be kept thoroughly insulated and free from leaks to ground. The covering for the wire should be capable of resisting moisture, and the wire used be strong enough to prevent any possible breakage. If the primary wires break and come down, they are still kept charged from the dynamo, which is not always the case with arc light lines. If, however, the insulation is strong and perfectly good, the risk to life is small in such case. There is one fact I wish to impress, however, and it is, that, with a perfectly insulated set of alternating primary mains feeding transformers, there still remains the static capacity of the line or cables and transformers, and this may be of an amount sufficient, if a person is grounded and touching the primary line, uninsulated, to give a severe if not a fatal shock. This inductive shock or discharge is, of course, far more pronounced with ordinary underground conductors than with aerial lines, and increases with the size and number of transformers and the extent of the line. It also increases as the voltage of the primary line is increased. Hence, it is quite important that no leak or connection exist between the primary line and a secondary in such system, or otherwise there may be a transfer of potentials of the primary line to the secondary so as to involve risk of shock to the consumer, or risk of fire from leaks to ground indoors. It will not do to say that such connections do not often form, for they may form from defects in construction, from moisture, and particularly from lightning discharges. A person standing on a damp floor, leaning on a steam radiator, touching a gas pipe grounded, or in other ways, may, if he handles or touches the secondary line at any part of it, be in peril of severe, if not fatal, shock. What was without this condition a most harmless local line, becomes most dangerous.

The writer early recognized this danger, and felt that unless it was provided for, the induction system was not advisable for general use. As a consequence, the expedients of grounding the secondary, or of surrounding the secondary by a grounded sheath, or of cutting off absolutely by automatic means the local line when connected with the main line, or of automatic grounding of the secondary by insulating films or spaces which are punctured or overcome by the potential of the primary when connected with the secondary, were devised as safety devices. The grounding of the secondary is the most simple and effective if good grounds be made. It must, however, be done with certain precautions to insure the best results.

The second expedient of a grounded metallic sheath between the primary and secondary is persistently called "Kent's sheath" when alluded to by our English cousins, despite the fact that it is American in its origin. It is effective as a protector, as it carries to ground any discharge leaving the primary before it reaches the secondary. The sheath is easily made by placing a somewhat open wrapping around either the primary coil or the secondary coil of the transformer made of flat metallic ribbon or insulated wire, the ends of which are grounded when in use. The course taken by the wrapping is around the wire of the coils at right angles to its direction of winding. The automatic absolute cutting off of the connection between the transformer coils is also effective, and has undergone several modifications in other hands. The last protective device mentioned above leaves the secondary insulated from the ground until a contact or leak from the primary takes place, when an automatic ground is made. One of the forms consists in the interposition between the ground and the secondary coil or line of a film cut-out, or thin paper film between two metal buttons pressed together, one button connected with the ground, the other with the transformer secondary. This device is very effective in securing a safety ground connection of the secondary when the primary leaks to it. A well constructed transformer properly installed will not, except by accident, lose its insulation between primary and secondary, and such insulation should always be many times that otherwise requisite, so as to have a margin of safety; but the safety device is none the less a necessity in its use.

I consider that a properly arranged double wire cable, well insulated, constituting the primary line, laid in ventilated pipes underground, transformers connected therewith, also enclosed in a grounded metal case, as in the cellar of a building, a secondary line of low potential, grounded, or provided with safety devices as mentioned, embodies as safe a system of incandescent electric light distribution as can be devised, both as to risk to life and danger of fire. It ensures complete safety to all the consumers, and to each one individually. It enables long distance work to be undertaken, and allows low voltage lamps to be used with their increased economy. The risks are confined to the electric station and the primary lines, which should be handled by men who know their business. The non-commutation of the current at the generators is another advantage, of course. The disturbing influences, which in the best organized plant may be introduced by lightning, are serious and sometimes destructive. It is not that the lines are struck by lightning in causing such troubles, but the mere *inductive* current or discharge from a flash of lightning is quite sufficient. It puts upon the line potentials of many thousands of volts and tends to break down insulation everywhere. Lightning arresters are, therefore, important safety devices in more senses than one. They save the machines in the station and the apparatus outside. In the alternating system they save from puncture the insulation between primary and secondary coils of transformers and between the turns of the primary coil itself. Every plant, then,

should, if subject to lightning induction, be provided with efficient lightning arresters or dischargers.

A discussion of this general subject, however brief and necessarily restricted in scope, would be very incomplete without allusion to the subject of contact with telephone or telegraph wires with electric light conductors. Underground and in conduits such contacts could not easily occur, though leak might readily take place between lighting conductors and other wires. In any case, there is a risk of such wires carrying current into buildings or to positions bringing about shocks to persons, thus involving risk of fire or danger to life, or both. As a consequence, a set of safety devices have been brought out under various names whose purpose is to cut off dangerous currents when they reach or traverse lines, such as those of the telephone or telegraph. It is my opinion that in cities the provision of approved devices of this kind should be compulsory. Most of those which I have seen are not well enough designed or made to be perfectly relied upon, but are much better than nothing and may possibly suffice. Such apparatus, however, should be made so as to be perfectly reliable and undergo a regular inspection. Mere fuses, even if made long, are not enough. There should be placed in every circuit liable to contact with lightning or such like conductors and at a place in the circuit where it enters a building, a protective device which, to be complete, should shunt or absolutely cut off the section of wire indoors, or ground the same in case of abnormal current on the wire or abnormal potential.

There is much more to be said on this subject, and I am conscious of only having touched upon certain important matters in this paper. If I have succeeded in pointing the way to better conditions in any case, I shall be more than satisfied.

To sum up, briefly, safety in outside work means care in placing, maintaining and insulating conductors, whether used overhead or below ground. This means the employment of only good linemen, and not men who are ready to incur risks through a reckless disregard of conditions of failure to comprehend their importance. Men who have done telephone or telegraph line work are not necessarily prepared to undertake electric light and such other work with the best success. Safety in inside work means, primarily, if admissible, separation of the inside circuit absolutely from the general supply mains, and in any case it means that good, careful workmanship is requisite, and that the employment of safety devices, amply sufficient to do the work required of them in case of accident, is imperative.

Safety from current entering buildings upon telephone, telegraph and other wires, means, first, a more systematic placing of such lines apart from electric mains, whether above ground or below, guard wires and insulated wire for such lines, stronger wire, especially for telephones, and the employment of safety devices in case of accidental leaks or crosses occurring with electric mains, of either low or high potentials, and a periodical inspection by proper officers.

Mr. Lockwood: I have but very little time to study this paper of Professor Thomson's. I am sure that every member of this Convention must feel, in the present condition of electric lighting, the need of safety devices. I hope, that by the time this Convention adjourns, we will get ideas enough regarding all possible means for safety, so that when the next annual Convention meets, we will have a year's record that will compare with any record that could be asked for. I do not want to be understood that I am now using in my station every device that I advocate, because I am not. But they will all go in there with the greatest possible haste that I can get them in, and do the work thoroughly, and from that period I am going to keep our station, in the matter of safety devices, at the head of the list as far as lies in my power.

On this question of lightning arresters, it is not so much a question of preventing accidents to the employés and to the public. I do not think it is as necessary as some other devices, but it is one of the simplest and best things that can be provided for safety with our present knowledge.

Professor Thomson speaks of the advantage of using high potential as a measure of economy in fuel and other expenses. I think that we all agree that the more we can centralize our work, the cheaper we will be able to operate our lamps, and the more carefully can we supervise the work that is being done and maintain everything at the proper standard. He speaks of the fact that the dealing with the wire question by the authorities in New York City has been very severe, but yet thinks it will lead to final benefit to electrical interests. I think the question as to whether that would be so or not, depends upon no one thing more than how we keep our circuits supplied with safety devices from this time forth. I think that doing so, will do more to solve the question than anything else. I think if we do not pay great attention to adopting means to denoting a ground when it occurs on a circuit, and then locating it and finding how it can be removed in the shortest possible time, and seeing that in all ways they are kept clear and free, I do not think we will have the success that we should have.

I will have to make my excuse to the Convention for any further remarks, because I made no preparation for this discus-

sion, and trust that other members who are far more competent to discuss it, will give their advice upon it and thus enable us to get the full benefit of this paper and the discussion which should follow it.

MR. M. D. LAW: In the matter of lightning arresters, I think we have a very important species of safety devices for central station work. Not only does it protect the dynamos, but it protects the insurance companies against loss by fire. Before the adoption of lightning arresters in our station in Philadelphia, we had three fires in buildings in different sections of the town, which were caused by lightning coming in on our lines, but since the introduction of lightning arresters we have lost no dynamos, have had no fires and have lost but very few insulations. Another important feature of lightning arresters is their protection to underground cables in taking up the so-called static discharge of the dynamo on the interruption of the circuit. I find it very valuable in that respect. The matter of cut-out boxes is another very important feature, and they should be placed on every part of the circuit where it goes inside of a building or is attached to a building or a loop going over any street; it gives you perfect control of that circuit in case of fire. That was clearly demonstrated to me about two months ago at a fire we had in Philadelphia. I was at the fire very soon after the alarm, and found we had a loop going up in the rear of the building. I discovered there was no box upon that pole, for which my foreman received very severe censure. I was obliged to put in a cut-out to cut those wires loose. Had I a cut-out box there, it could have been done much quicker and much more safely.

CAPTAIN WILLIAM BROPHY: I wish some one who had better control of the king's English than I, could do justice to the barbarous treatment the electrical fraternity have received at the hands of the so-called underground commission of New York. (Applause.) I cannot do justice to the subject. I agree with Professor Thomson in all he says in regard to that subject. A few men, selected without any regard to their qualifications for the positions they hold, sit in judgment and throw a large city in total darkness without making any provision for any other form of light, and, as it were, turn the whole city over to the

hands of thugs and criminals. I believe, myself, that the insulation of overhead wires is only a question of dollars and cents saved to the parties who are operating the central station. I do not believe it solves the problem of preventing accidents to life and accidents by fire. An unused wire that no one cares about can drop down and saw its way through in half an hour, and some one will come along and complete the circuit from the wire to the ground and be the victim, and the press sends the news all over the land, giving no explanation of how or why it was done. So far as safety to the public is concerned, if you will run your wires well up in the air, if you can get the right of way to do so, it matters little whether they are bare or insulated; but if you want to carry on a successful business, it is your duty to properly insulate your wires. Until the municipalities or some other power will protect you from the tramp wire, the poorly constructed wire, and the many other roads through which death and destruction may be carried, as they say, you cannot be held responsible for these accidents, and until you have the right, and the clear right, to run your wires without being menaced by such things as these, you cannot prevent accidents of this kind. (Applause.)

THE PRESIDENT: If there is no further discussion on the topic, it will be passed with the usual instructions to the Secretary. There being none, it is so ordered.

The next order of business will be the report of the Committee on Electrical Data.

MR. DE CAMP: I am not the chairman of that committee. Mr. Foote is the chairman, but I submit the report and will ask the Secretary to read it.

Secretary Garratt then read the report of the Committee on Data as follows:

REPORT OF THE COMMITTEE ON DATA.

MEMBERSHIP.

1. The membership of the Committee as now constituted, is as follows:

A. J. De Camp,
C. R. Huntley,
E. F. Peck,
Edwin R. Weeks,
Allen R. Foote, Chairman.

WORK DONE.

2. This Committee has printed in pamphlet form and distributed to central station companies, the paper read at the Tenth Semi-Annual Convention of the Association on "The Value of Economic Data to the Electrical Industry." Accompanying this pamphlet, a circular of inquiries was sent, inviting the suggestions as to the items of data which those addressed considered desirable to be collected, also the form of accounts, reports which may be used to establish a uniform system of accounts with a view of rendering the data obtained from them reliable and valuable.

3. The responses received, by correspondence and personal interviews, leave no doubt in the minds of the Committee as to the general appreciation of the value of the work to be undertaken and of the cordial co-operation of central station companies in carrying it to a successful consummation.

CENSUS DATA.

4. In view of the fact that the United States Census Office is now engaged in preparing schedules for obtaining certain data relating to the electrical industry, this Committee think it best to suspend the work of formulating reports for the purpose of obtaining data until after the work of the Census Office shall have been officially published. The Committee can then devise such report as may be supplementary to, or a continuation of, the work done by the Census Office, thus increasing very greatly the value of the work it may do.

5. With the above object in view, the Committee has given special attention to the work of assisting the formulation of a special schedule for central station companies for the use of the Census Office. The outlines of this schedule have been submitted for suggestions to upwards of 30 of the largest companies in the country. A representative of each company has gone over the entire subject in detail individually, and made the suggestions as seemed to him to be pertinent. The entire schedule is now in process of revision in the light of these suggestions. When this work is accomplished, it will be again reviewed by this Committee. In case the schedule, as then submitted, is satisfactory, this Committee requests the authority of the Association to approve of the schedule in the name of the Association.

THEORY VERSUS FACTS.

6. The first decade of the history of the electrical industry was necessarily the decade of the theory and experiment. A decade in which large sums of money have been invested on the basis of representation made by manufacturers as to what their apparatus or construction was expected to do. During this period, the time of the Conventions of this Association has been largely consumed by long and, sometimes, exciting discussions over this or that feature of the business in which all were engaged. No satisfactory solution has been reached by such discussions, because arguments were based on what was expected to be, instead of upon what was.

7. In entering upon the first year of the second decade of electric light

history, it will be well for the Association to draw a sharp line of demarkation, and cease to discuss subjects from the standpoint of theory. It should substitute therefor the standpoint of facts. Not that the days of theory and experiment are over; that will never be. But the days are over when to have an electrical service at all, it must be accepted on faith in promised results. The time has come when we can afford to wait for the adoption of a new idea, or new application of an old idea, until it has been put into practical use for sufficient time to enable their claim for general adoption to be based on accomplished results.

Mr. De Camp moved that the report of the committee be received, and the committee continued with such changes in the membership of the committee or additions as he should think it was proper to make.

The motion prevailed.

SECRETARY GARRATT: In the seventh clause of the report, it says: "Entering upon the first year of the second decade of electrical history." I think that should be amended so as to say, "electric light history." Electrical history runs back several centuries.

MR. DE CAMP: I want to submit as supplemental to the report we have just received the following resolution.

The resolution offered by Mr. De Camp was then read by the Secretary, as follows:

THE INVESTIGATION OF THE ELECTRICAL INDUSTRY BY THE UNITED STATES CENSUS OFFICE.

Whereas, The superintendent of the United States Census has appointed a special agent for the investigation of manufacturers of electrical apparatus and supplies and their uses; and,

Whereas, This is the first official investigation that has ever been made of this subject, in this or any other country; and,

Whereas, It is the opinion of this Association that such an investigation will be of the very highest value as a means of furnishing the public with information that it can accept as being reliable, impartial and authoritative, and for that reason will be of great value to those interested in the electrical industry; and,

Whereas, This Association, in behalf of the electrical industry of the United States, desires this investigation to be thorough and complete in every detail, and is aware that such an investigation could not have been fully authorized and provided for, on account of the newness of the industry, when the law providing for the census of 1890 was enacted;

Be it Resolved, by The National Electric Light Association in Convention assembled:

First. That it respectfully petitions the Senate and House of Representatives of the United States Congress, to authorize and direct the superintendent of census to collect the following data in relation to the electrical industry, in addition to the general statistics of manufacturers already provided by law:

(*a*) Details pertaining to underground and aerial construction, underground and aerial currents, the character of voltage of all currents and their uses; lamps in use, arc and incandescent, and how wired for residence, commercial and municipal service; motors in use for stationary service and motor cars, income and expenses, etc.

(*b*) An inquiry, through sources independent of those interested in the industry, as to the casualties resulting from the use of electric currents, both as to fire and personal injuries. This investigation to be made in all cities of 10,000 population and over. The information to be obtained from underwriters, the records of fire departments, coroners' statistics, health boards or commissioners, or from whatever source of information that may exist in any city. The investigation to make a comparative statement between the casualties resulting from the use of electric currents and the use of other agents employed for similar purposes.

Second. That we hereby petition that an appropriation of not exceeding $50,000 be made for the purpose of this investigation.

Third. That The National Electric Light Association, hereby tenders its thanks to the Hon. Robert P. Porter, superintendent of census, for the recognition he has given to the importance of, and wonderful progress made by, the electrical industry, by the appointment of a special agent for its investigation, and we hereby pledge our cordial co-operation with the Census Office in its efforts to make the investigation thorough, reliable and complete in every detail.

Fourth. That a copy of this preamble and resolutions be properly engrossed, officially signed by the President and Secretary of the Association, and transmitted to the Chairman of the Committee on Census, of the Senate and of the House of Representatives, and to Hon. Robert P. Porter, superintendent of census.

MR. DE CAMP: In order that you may understand the purpose of this resolution, I will state that there has been a kindly and co-operative disposition on the part of the census department to separate our branch of industry and make it a special section, but it has certainly proven to be true that the chief of the department did not contemplate the scope of the work to be done. To be of value it must be done thoroughly. I am rather inclined to think that the form of blank, etc., that would be necessary involved more expense than the chief of the census department contemplated when he first took the matter up. However, there seems to be no doubt but that this additional

appropriation can be secured; but out of courtesy to the chief of the department, if nothing else, as he has taken an interest in it so far, we ought to back him up with the strongest petition we can possibly present. In addition to this resolution, petitions have been sent out for signature to some 2,000 people. I sent in a very strong petition from Philadelphia, and we sent a copy to many places accompanied with a blank petition. Many of you may not have received those petitions, but, if you have not, you will receive them when you return home, and I wish that you would return those petitions if they are signed by only one or two. This should be done promptly, because we have got to work promptly if we do not wish to fail in this work of initiating an electrical department and doing it well at the send off.

Dr. A. H. Mason moved the adoption of the resolution.

MR. FLOWER (of Texas): I am not a member of the Association, but I would like to suggest that the resolution should apply to cities of 5,000 inhabitants as well as 10,000.

THE PRESIDENT: The gentleman is not a member of the Association, but the committee may accept his suggestion.

MR. DE CAMP: The resolution is before the Association as formulated by the committee, and I would not like to alter it on my individual responsibility. I think that $50,000 will hardly cover the ground of the work as it should be conducted in the cities named in the resolution.

The motion of Dr. Mason to adopt the resolution was then put and unanimously carried.

Mr. Lawrence, of Cleveland, then offered a resolution which was handed to the Secretary.

Mr. F. A. Wyman rose to the point of order that all resolutions should go to the Executive Committee and be approved by them before being presented to the Association.

The President then announced that the resolution was referred to the Executive Committee.

MR. DE CAMP: On what rule of the Constitution is that based? A resolution is presented and you announce that it is referred to the Executive Committee.

THE PRESIDENT: It is based on the provision of the Constitution that the Executive Committee shall arrange and provide for the programme and the order of exercises.

Secretary Garratt: I am responsible for this resolution coming in in this way. I was asked if it was appropriate for Mr. Lawrence to introduce a resolution, and I said that it was. If I am in error I stand corrected. I told him to have the resolution drafted and either read it himself or hand it to the Secretary.

Dr. Mason: Mr. President, have you given us the only authority for your decision?

The President: That is the authority; yes, sir. There is in addition to that the authority that might be cited, that it is submitted by an associate member, and should come through an active member.

Dr. Mason: I understand that associate members have all rights, except those of voting, as recited in the Constitution.

The President: The decision of the Chair is based upon the provision in the Constitution. It is immaterial, however, if it meets with the concurrence of the Convention.

Dr. Mason: I would be glad to have that matter decided by the Association, through an appeal from the decision of the Chair. I do not wish any disrespect in the appeal.

The President: Certainly not. My ruling was on the way the matter presented itself to me.

Dr. Mason: I appeal from the decision of the Chair. I think this question should be settled; it is a very important one and should be settled now. I do not think it was the intention of the Association ever to repose in the Executive Committee such an exclusive power as this, that no business can get to this Association except through the Executive Committee. If that is what is meant, let us know it.

The President: I do not understand that to be so. That is, as to matters pertaining to the arrangement of programme and exercises. All matters must come through the Executive Committee—all such matters as is distinctly stated by our Constitution.

Dr. Mason: Of course, we are all in the dark, I presume, as to the character of this resolution, but I would like to have it decided whether a member of the Association can present a resolution to the Association direct, or whether it must go through the hands of the Executive Committee.

The President: I think it can be presented directly to the

Association if there is no interference with the order of business upon the table. There being no interference in this case, I think I will have to reconsider the position taken upon that. (Applause.)

MR. F. A. WYMAN (of Boston): Mr. President, I rise to a question of privilege, and ask if it is not clearly stated in the Constitution and By-laws that all papers and resolutions that are presented before the Association shall pass through the hands of the Executive Committee?

THE PRESIDENT: It does not state all papers. I will ask the Secretary to read that section of the Constitution.

SECRETARY GARRATT: I have not a copy of the Constitution here, but I think I can set the gentleman right. The Constitution states that it is the duty of the Executive Committee to examine all "papers," but it does not state that all resolutions shall pass through their hands. It has been the practice of the Association to have important resolutions pass by way of the Executive Committee, but they do not of necessity go that way.

MR. LOCKWOOD (of Detroit): I have here a copy of the new Constitution which you may have.

SECRETARY GARRATT: The Constitution says that the Executive Committee shall be the governing body of the Association; that it shall meet upon the call of its Chairman from time to time, and shall report upon applications for membership, shall gather proper information upon topics of interest, and see they are arranged for discussion by the several members of the Association. Five members of the committee shall constitute a quorum.

MR. DE CAMP: I may state that I have been a member of the Executive Committee, either direct or *ex-officio*, ever since I have been connected with the Association. I will enlighten the gentleman who has just spoken, as I see how he has been misled. The Executive Committee have been in the habit of revising the papers which have been presented, for the purpose of relieving the Association of the cumbersome amount of papers to be read for discussion before the Convention. It has always been the case that there was more good material presented than it was possible for us to get through with; and, therefore, all such papers were referred to the Executive Committee, to decide which were of the most general interest to the Association.

Mr. Wyman: I would like to ask the gentleman who was last up if it was not the feeling at Niagara Falls, that all things should go before the Executive Committee, in order that advertising schemes should not be thrown on the Association?

Mr. De Camp: I presume if the resolution should take the form of an advertising scheme, the Association is perfectly competent to sit down on it peremptorily.

Mr. Alexander: Mr. President, if an associate member appeals from the decision of the Chair; how do you decide that point? Can an associate member appeal from the decision of the Chair?

The President: No, sir; I think not.

Dr. Mason: Does not the Constitution recite that associate members shall have all privileges except those of voting?

The President: Ana ppeal from the decision of the Chair is a privilege so nearly akin to that of voting, that, in my opinion, it comes under that exception. The matter was presented by an active, rather than an associate member. We will admit the resolution.

Mr. Wyman: I move the resolution be laid on the table.

Dr. Mason: That cannot be done until it is read.

Under the direction of the President, Secretary Garratt read the resolution which was as follows:

Whereas, The present classification of electric light carbons is much higher than other commodities of corresponding weight, bulk and liability to damage; packages less than car lots being rated as first-class, and car load lots as third class; and this classification was made years ago when few carbons were manufactured, when they were high priced and supposed to be very liable to damage; but are now among the cheapest shipped, are compactly and securely packed, easily handled and not liable to damage in the ordinary risks of transportation, which is demonstrated by the fact that no claim for breakage of, or damage to, carbons has ever been preferred to the railroad;

Therefore, be it resolved, That The National Electric Light Association in Convention assembled, considers the present classification unjustly burdensome, and believes the interests of all electric light companies will be promoted by reducing the classification, and that greater volume of traffic and corresponding gain to the railroad companies will accrue;

And be it further resolved, That this Association endorses the efforts of the committee of carbon manufacturers appointed to make application to the general freight classification committees of the United States in furtherance of this resolution.

Dr. Mason: I move the adoption of the resolution as read. (Seconded. Carried.)

The President: I think your President will have to apologize in this matter, and in future keep the people from the back of the platform, as they distract his attention.

Mr. Huntley: I move you, Mr. President, that the Chair appoint a committee of five on nomination of officers and place of meeting for the ensuing year; and that the committee so appointed be requested to report at the opening of the session to-morrow morning. (Seconded. Carried.)

The President: I will appoint as a committee on nomination and place of meeting, the following members: Mr. Huntley, Mr. Francisco, Mr. Peck, Mr. De Camp and Mr. Beebe.

Mr. De Camp: Mr. President, now I move you that when this Convention adjourns at Kansas City, that it adjourns to meet in the month of August, 1890, at such a day as the Executive Committee shall decide upon, to meet at Cape May, New Jersey.

Colonel Ransom: I desire to second that motion, and in doing so to state that I suppose you are all well aware where Cape May is. It is two hours' ride from Philadelphia and four from New York. There is at Cape May, the Hotel Stockton, which has 400 rooms, with a capacity for 800 persons, for the meeting of the Association. There is also ample committee room, free of charge. There is a fine orchestra in the house during the Summer to give concerts in the morning and hops in the evening. The Stockton is strictly first-class. The rates, according to location of rooms, are, $3.00, $3.50, $4.00 and $5.00 per day. There is also power for exhibition purposes, 140 horse-power, which can be had free of charge. Colonel Walton, the proprietor of the Stockton, came on from New York with us, and has been here a number of days; and we who know him best think we would like to be under his charge while at Cape May. Your resolution says nothing in regard to the Stockton, but to go to Cape May is to go to the Stockton. I desire to second the motion of Mr. De Camp. (Carried.)

Dr. Mason: I move we adjourn to 9.30 to-morrow morning. I do wish if that is not the hour to which the gentlemen desire to adjourn, that we adjourn to meet at some other hour, that we may commence promptly in the morning. (Motion seconded and carried.)

THE PRESIDENT: I will call the meeting to order promptly at 9.30 to-morrow morning.

Whereupon the Convention adjourned to meet at the Coates' Opera House, February 14th, at 9.30 o'clock, A. M.

FOURTH DAY'S PROCEEDINGS.

MORNING SESSION.

Promptly at 9.30 o'clock, A. M., President Weeks called the Convention to order, Secretary and Treasurer A. V. Garratt, at the Secretary's desk.

THE CHAIR: We have for the first business this morning a special order, which is the report of the committee on nominations of officers for the ensuing year. The chairman of that committee is Mr. C. R. Huntley.

Mr. Huntley presented the report of the committee, as follows:

Mr. Chairman, your committee would respectfully report action, and beg leave that the Secretary may read the report.

Secretary Garratt read the report, as follows:

REPORT OF THE COMMITTEE ON NOMINATIONS.

For President, M. J. Perry, of Providence, R. I.; For First Vice-President, E. A. Maher, of Albany, N. Y.; For Second Vice-President, C. L. Edgar, of Boston, Mass.; For Executive Committee: C. R. Huntley, Chairman; E. R. Weeks, Kansas City, Mo.; James English, Bridgeport, Conn.; S. A. Armstrong, Camden, N. J.; M. D. Law, Philadelphia, Pa.; M. J. Francisco, Rutland, Vt.; A. F. Mason, Boston, Mass.; John A. Seeley, New York; H. K. Thurber, New York.

THE PRESIDENT: Gentlemen, the report of the committee is before you, what is your pleasure?

DR. MASON (of Boston): The Constitution calls for a ballot on this subject, does it not, upon the recommendations made by the committee? Therefore, a motion to adopt the report would not be proper. I desire, sir, in a word of explanation, to make a nomination. I think that every member of this Association recognizes, with something akin to gratitude, the very felicitous, the very remarkable services of the present President

of this Association. I believe that I do not speak for myself alone, but for every member of the Association, when I say that we have had an exceptionally profitable as well as enjoyable meeting here in Kansas City; and that very largely this is due to the efforts of our President, Mr. E. R. Weeks. I, therefore, desire to put in nomination for the Presidency of this Association for the ensuing year, Mr. E. R. Weeks, of Kansas City. (Applause.)

Mr. De Camp (of Philadelphia): Mr. Chairman and gentlemen of the Convention: That nomination being made outside of the committee, I think it requires a second. I arise to second the nomination. As a member of that committee, whatever may have occurred to the committee, as having been done strictly in the interest of the Association, by the nature of our business, and what is contemplated for the future; and however much I might accord with the committee with which I am pleased to say I am fully agreed, I cannot do otherwise than second that nomination. Whatever we may be glad to do as a body of men, we certainly owe one thing, and that is a proper appreciation for those who have already served us. I think I am justified in saying, of all the meetings that this Association has had, of which I have attended, from step to step, there has been evidence of a healthy growth. But like the growth of our country, we have in that total growth made a stride. The step from our last meeting to the present, comes under that class—it is a stride! This is the most largely attended meeting we have had. There has been the most interest taken in it, and our work has been of the most practical kind, and I think that it has been due very largely, if not entirely, to the efforts made by the President of this Association. He has been, during the last six months, at work constantly, or results such as we see before us could not have been accomplished. I would be glad to have him fully appreciate the feelings of this Association, as well as I know the Association and its members individually, appreciate the efforts of its officers in the past. I heartily second the nomination of Mr. Weeks as President. (Applause.)

The President: Gentlemen, your action in this matter is gratifying to me, in that it evinces your approval of the administration just drawing to a close. Next to the consciousness of

having done one's best, comes the approval of one's friends and associates; but, gentlemen, my views of the Presidency of this Association have not changed. It is my opinion that the President of The National Electric Light Association should be a citizen of one of the large eastern cities, one of the great electric centers, if I may so speak, of the country, where he can carefully watch all movements affecting the interest of the industries that we represent. Kansas City is not such a center, although Kansas City will some time undoubtedly be just such a place and the place where, for this very reason, the President of some future Convention of this Association might well be located; it is not now so. I, myself, have during my administration felt frequently the disadvantage of distance; and if the interests represented in this Association have not suffered, it has been due largely to the zeal and support of the eastern members, it has been due largely to the vigilance of our Secretary and to the earnest watchfulness, the zealous application and industry of our eastern committee. The success of this Convention, gentlemen, which has been so kindly attributed to me, is due very much more to the combined effort of these gentlemen who have supported the administration and have looked out for the interests of the Association so carefully, than it is to your President.

For these reasons, gentlemen, I feel, much as I appreciate the honor you offer me, that the best interests of this Association require the election of the officers nominated by your committee. In the expression that has been made and in the increasing prosperity of this Association, in the strengthening of the Association throughout the West, which was the reason for my acceptance of this office, I find my reward. I thank you, gentlemen, for your offer but for the reasons stated must respectfully decline the nomination. (Applause.)

Mr. E. A. Armstrong (of Camden, N. J.): The committee very kindly suggested my name as a member of the Executive Committee. I am so placed that I feel that it would be unwise, both in justice to the duties of the position, and unwise from a personal standpoint, for me to accept the place. The New Jersey member of this committee will needs do a great deal of work. I am so placed officially and otherwise as to be unable to give

the time that ought to be given. I appreciate very heartily the compliment paid me, and would ask that I be relieved from that position, and would suggest that the general manager of our company, who is here, would much more efficiently fill the place, and would answer to every good purpose that I could were I there, and if the committee will only accept that suggestion and nominate in my place Mr. John J. Burleigh, I should be obliged.

Mr. De Camp: I understand Judge Armstrong nominates Mr. Burleigh in place of himself. I take that as a nomination perfectly in order. As Judge Armstrong's nomination was made by myself, or at my suggestion, by the committee, I must confess that at the time I had some doubts as to whether Judge Armstrong could or would be willing to give the time and attention necessary to serve on that committee. I heartily second the nomination of Mr. Burleigh as a substitute for Judge Armstrong, a gentleman who is thoroughly competent in every particular, and a man who can be of much use. I like to have men on that committee that we can get our hands on once in awhile.

The President: Gentlemen, the report of the committee is before you. The Constitution provides that it shall be voted upon by ballot. The Secretary will proceed to call the roll.

Dr. Mason: I understand that a motion has been made and seconded for the substitution of Mr. Burleigh in the place of Judge Armstrong.

The President: I understood that to be accepted by the committee, and, therefore, incorporated in their report. However, I will put the motion.

The motion to substitute Mr. Burleigh in place of Judge Armstrong was then put and unanimously carried.

Mr. Phelps (of New York): I believe I am entirely in order to move you that the Secretary be instructed to cast the ballot of the Association for the officers and members of the Executive Committee as reported by the committee. If I am, I will make that motion.

The President: That is entirely in order.

The motion to instruct the Secretary to cast the ballot of the Association for the officers and members named in the report was then put and carried, and the Secretary cast the ballot.

The President: I declare the election of the following offi-

cers of The National Electric Light Association: President, Mr. Marsden J. Perry, of Providence, R. I.; First Vice-President, Edward A. Maher, of Albany, N. Y.; Second Vice-President, C. L. Edgar, Boston, Mass. Upon the Executive Committee: C. R. Huntley, Chairman, Buffalo, N. Y.; E. R. Weeks, Kansas City, Mo.; James English, Bridgeport, Conn.; J. J. Burleigh, Camden, N. J.; M. D. Law, Philadelphia, Pa.; M. J. Francisco, Rutland, Vt.; Dr. A. F. Mason, Boston, Mass.; John A. Seeley, New York; H. K. Thurber, New York.

MR. DE CAMP: You read Mr. English's name as being from Bridgeport.

SECRETARY GARRATT: It is so written in the report; he is connected with the Bridgeport Electric Light Co., but he lives in New Haven. It is the James English whom we all know.

THE PRESIDENT: Is the committee upon resolutions in regard to the death of members ready to report? Mr. Degenhardt, Chairman.

SECRETARY GARRATT: I believe the Secretary was a member of that committee. I have not been instructed by the other members in regard to any meeting. I will endeavor to get them together and have a report before this afternoon.

THE PRESIDENT: The next order of business will be a paper by Mr. Frank J. Sprague, of New York, on the subject of Electricity as Applied to Street Railways.

Mr. F. J. Sprague, of New York, presented the following paper:

APPLICATION OF ELECTRICITY TO STREET RAILWAYS.

BY MR. FRANK J. SPRAGUE.

Mr. President and Delegates: Scarcely 15 years—a period of time yet within the memory of the youngest of us—have passed since the beginning of a new era, the transmission of energy for light, power and the reproduction of speech. Of the progress of the first I need not speak, for the delegates of this Convention are well cognizant of its history and the advance it has made within that time. The spread of the telephone to nearly every town and hamlet in the 14 years since it was exhibited as a scientific toy at Philadelphia, and the financial success of the parent company, are facts continually before your minds or ringing in your ears. But that great industry, the transmission of electricity for power, with its possibilities of all kinds, is of very recent development. Six years ago there were scarcely 100 electric motors in operation in the United States for any purpose; to-day there are no less than 15,000 motors in use, applied to not less than 200 different indus-

tries, and an industrial revolution is taking place equaling, if not surpassing, in importance that attending the introduction of the steam engine, and marvelous in the rapidity of its growth.

It is not my purpose to dwell at length upon the subject of the transmission of power by electricity in its general application, but to touch upon one branch only, that of railway work, reviewing very briefly the development in the United States, pointing out the salient features of successful operation, noting what has been already accomplished, and, after some remarks upon the legal questions which have arisen, considering the possibilities of the future.

The modern electric railway may be said to have been born in Europe; its babyhood was in Europe; but in its youth and younger manhood it is purely American. In 1881, Dr. Siemens, of Berlin, established the pioneer railway on the Lichtenfelde line, in the suburbs of Berlin, and I believe it is still running. It was followed by other roads, some commercial and others for exhibition, erected by the firm of Siemens, and by work done by other electrical engineers. The Siemens also established a line at Frankfort. The Doctor Hopkinson established one at Portrush, Ireland. Another was established at Blackpool. This last was a conduit system. A double metallic overhead system was established in 1888, at Vevay, Switzerland, and comparatively recently, the Siemens have established a conduit system at Buda Pesth.

The first line which was established in the United States for actual commercial service was a suburban line of two miles in length, built by Mr. Daft, just outside of Baltimore, in the latter part of 1885, using a central rail. Other lines were established by Mr. Vanderpoele in various parts of the country, using the single and double trolley system, with the trolley traveling upon and carried by the wire and connected to the car by a flexible cable.

In all this pioneer work the system used was that of direct supply, but most of the mechanical features as well as the electrical details have now given way to other and more efficient methods of operation.

Of the more recent work, three classes demand attention, one being the system of independent units operated by the storage battery, and the other two being direct systems of supply, one underground, the other overhead. I shall not enter into details of these three systems or their modifications, for it would be a repetition of much which has already been written, but I will briefly state the facts and the conclusion I have formed concerning them.

There is something exceedingly attractive in the proposed application of storage batteries to the propulsion of cars. To be able to conveniently store up a large amount of energy in a box, put it aboard a car, carry it around with us, and take from it a greater or less amount of work, offers, when practicable, a solution of the street car problem for which we are all devoutly hopeful. But look at it commercially. The storage battery is still a long way from being a serious competitor of the direct source of supply. True, great improvements have been made in it, but these improvements have not very much altered its character, or the weight which is necessary, or the care which must be exercised in getting an economical return from the battery. These

improvements have made it possible to take a heavier charge from the battery without producing buckling, have made a rougher usage of the battery mechanically possible, and have in some instances greatly reduced its cost of manufacture, so that the element of maintenance is a less serious one than it was a year or two ago; but the capacity of the battery, while it has been somewhat increased, remains such that it is still necessary to have about 3,500 pounds to propel an ordinary street car. This means an excessive weight. It takes up space and is a serious extra load to be carried around. It requires frequent shifting, and its capacity as well as discharge rate are so limited that it is simply impossible to work such a battery upon grades which are at all severe. I believe it is possible with care to operate a storage battery on grades not exceeding, say, four per cent., and with limited speed and daily mileage at an expense about equal to that of horses, or a little less, but still at about double the expense which is necessary upon a suitably erected and properly operated overhead system.

Nowhere in the United States, that I am aware of, is there serious storage work being done at the present moment. The nearest attempt was where recent experiments were made on the Madison Avenue Line, New York City, where about a dozen cars were being run up until 8 o'clock in the evening, but owing to legal complications, only two cars are now running there—with what daily mileage I do not know. But nowhere is the work done at all equivalent to what is constantly practiced on the overhead line. On that service, motor cars start out at 5 or 6 o'clock in the morning and run until midnight. Many cars make 150 or 160 miles a day, and some cars have even made 180 and 190 miles a day. Half of this for storage battery work is good duty, but it is not up to the demands which street railway managers make, and until the radical improvements which are promised are made in it, the field of application will be limited.

The conduit system of direct supply has been attempted in several places, notably at Denver, Cleveland, Allegheny City and Boston, but at all the places mentioned these experiments have proved disastrous and have been abandoned, save the short section at Allegheny City, In England, the Blackpool line, under special conditions, has been, I believe, fairly successful, and at Buda Pesth, the Messrs. Siemen have a conduit system in successful operation. There, however, the drainage is very perfect, and, in addition, a man is detailed for given sections of the track, and is continually employed in patroling his section and clearing it out. Assuming good sewerage, the conduit can unquestionably be made to work. It becomes then a question of cost; but for general application, especially in view of the fact that most of our cities do not have a sewerage system which can take care of the street drainage, the expense is prohibitory save on large systems under exceptional conditions. I look forward to the time when many existing well constructed and well drained cable conduits will become electrical conduits, and electricity will then score another victory.

The system, however, which has made such a marked advance is the single trolley overhead system with universally flexible underneath contact, and

this has been the growth of the past two and a half years. I think I can fairly claim for the Sprague Company the pioneer place in this development, but the commercial development on the lines it laid down has been with great energy pushed forward principally by both it and the Thomson-Houston Company. The first work done by the Sprague Company, other than experimental work on the elevated railroads, was made but a short distance from this city. A single car was started in 1887 on the Union Passenger Railway Company's line in St. Joseph, with a small 7½ horse-power motor, single geared, and adapted to run at a very high speed on a suburban extension. It is a matter of interest that the road has seen nearly every change made in the system. Its lines have been extended twice, and it has both the old style motors and the more modern equipments. But all the work done on that line was, it may be said, purely experimental, and it was not until the 2d of February that the Richmond road was officially opened to the public. I speak of this road, not so much because of my personal interest in it, but because it marked an era in the development of electric railways. A radical departure was made from the work which had been done prior to that time, not only in the amount and extent of the system equipped and the number of the machines operated, but also in the disposition and control of the machines, the system of overhead wiring, and the method of getting the current from the wire. The characteristics of that line are now pretty well known. It was a road of about 12 miles in length, with 30 curves, some of them of exceedingly short radius, with grades running as high as 10 per cent., and with a roadbed utterly unfit for the traffic which it had to support. The equipment was for 40 cars requiring 80 machines, and was to be operated from one central station. When first proposed, the attempt was looked upon with a good deal of ridicule, not only by street railway men, but by electricians themselves. The street railway men thought that the ordinary condition of street car service would make it impossible for a self-propeller car to ascend a grade exceeding five or six per cent.; and as for attempting a 10 per cent. grade, that was out of the bounds of reason. As regards the electrical problems, the motors, instead of being placed on the car body, flexibly connected by chain gearing or belts to the axles, were placed underneath the car, and flexibly and concentrically geared to the axles. They were uncovered and exposed to the mud and moisture, and to all the accumulations which might collect in the street. They were built to run on a 400-volt grounded circuit, and to run in either direction with fixed brushes. Insanity was a mild term to designate the mental condition of one who made these proposals. The motor man was confined to his ordinary platform and the regulating devices there situated. A wire of one-fifth of an inch in diameter was extended over the track, and supplied at intervals of its length by a wire carried alongside the street, where the strain upon the poles was least, and this main conductor was supplied at three or four central points by feeders from the central station. The current, moreover, was taken from this wire, not by a traveling carriage upon the wire, flexibly connected with the car, but by an arm reaching upward and pressing underneath the wire. This contact

arm, which is now technically known as the trolley pole, was placed in the center of the car and had a universal movement, resisting up and down displacement sufficiently to make a good contact with the wire, but at the same time free to follow all vertical deflections. In addition, it had a lateral movement of considerable reach, offering little opposition to any side deflections by the wire itself.

Well, Richmond has passed into history. It has had its vicissitudes, it has had its victories as well. But it remains with all its crudities and with all the accidents which have marked its career, as the one great step in advance, whose features in the main, have been followed in almost all the recent electric railways. Machines have been made larger, they have been made mechanically and electrically more perfect. Changes of detail have been frequent, but most of the characteristic features there outlined mark to-day nearly every electrical railway which is either in operation, in process of construction, or under contract.

Taking our work alone and that of 1887 as a basis, in 1888 it was trebled. The work of 1888 was quintupled in 1889. As to what it will be in 1890, I will not hazard a guess. Its strongest opponents two years ago are now its best friends, and the enterprise, for which it was then difficult to get a dollar investment, to-day demands the best thought and the most active energies of two great corporations and a number of smaller ones. The contracts for electrical equipments involve larger amounts than almost any other electrical enterprise. The business done in this year will probably be not less than $6,000,000. Every street railway in the United States is watching with eager eyes the developments of the rival electrical interests. The friends of the cable system are on the defensive. The advocates of the electric system are reliant and aggressive. Its flexibility, the ease with which it is extended, its adaptability to various conditions of service, its freedom from long continued breakdown, the marvelous advances which have been made in perfecting its apparatus, all insure its supremacy.

As illustrating the progress of electric railways, I may state that there are about 130 towns or cities in the United States with one or more electric railways in operation, construction or under contract, and that these roads comprise about 1,500 miles of track, equipped with 1,700 motor cars, requiring 3,000 motors, of an aggregate capacity of 45,000 horse-power, and steam and electrical generators of 25,000 horse-power. The roads in operation are making about 100,000 miles per day, and within three months the mileage will be doubled.

We still hear occasional discordant cries about the possibility of breakdowns, the cost of operation, the danger of the current, or the unsightliness of overhead wires.

This latter question is rather æsthetical than practical, for, as now erected, the railway lines are among the most costly, and with care can, in view of the service rendered, be made very unobtrusive.

As regards danger, the electric car is the safest possible vehicle, because of the remarkable facility of control, and as to the objections to the overhead

line on the score of danger, which have been raised sometimes by the municipal authorities, and which have been cited by the telephone interests, they are, we may safely say, imaginary rather than real. Some two years and a half ago, I settled upon 400 volts as a fairly satisfactory standard of potential for which the motor for street railway service should be built, allowing about 10 per cent. drop in the distribution on the line, making the potential in the station about 440 to 450 volts. In some cases, where dealing with heavy work on extended lines and small conductors, we have raised the potential at the motors to about 450 volts, making no change whatever in the machine, and have run the central station at 480 to 500 volts. There are in the United States about 80 electric railways in operation. Almost every employé of the contracting companies and a great many employés of the railway companies themselves, including not only the linemen, and those whose business it is to work upon the electrical equipment, but also the conductors and drivers, have received shocks from these lines, of greater or less duration, and under almost every possible condition. Yet in no instance which ever came under my observation, or of which we have any reliable record, has serious injury resulted from the shock of the current itself. When we consider that these shocks have occurred to persons of all ages and of all physical conditions, and for varying periods, the experience seems to be quite ample to warrant the assertion that as ordinarily constructed a constant potential circuit of 500 volts is not dangerous to human life, and we can dismiss that question.

Reviewing the work of the past two years, that which was promised for electricity has been in the main entirely fulfilled. It has proved itself capable of doing the most extraordinary work under the most unfavorable conditions. Grades of 12½ per cent., and more recently, of 14 per cent., have been ascended with loaded cars. Grades three miles long, varying from four to eight per cent., have been ascended by a motor car pulling a tow car. It has done work where it would have been impossible to have done it by horses. It has enabled the running speed of cars to be increased, even in crowded cities, 50 per cent.; and on suburban routes, speeds of 20 miles or more have been made. Experimental runs of 30 miles an hour on the ordinary street car with the narrow flange wheel, have been attained; and on special experiments, a speed of nearly 150 miles an hour has been made for a short distance. The electric car has shown that it can run faster on both up and down grades, that it can be gotten under way and stopped more quickly than a horse car; that with any given number of cars the mileage has been increased and the same time intervals made with a less number of cars. Many cars have made from 180 to 190 miles in one day. Horse space having been saved, the equipments occupy a third less space, and this fact, coupled with the ability to back when necessary, and again quickly gain headway, has enabled an electric railway car in crowded and narrow streets, to work its passage where a horse car would be at a dead standstill. Not only has the possibility of running down grade faster been established, but that possibility with a high degree of safety, because in the event of losing control of a car by the brakes, the instant reversal of the motor will bring the car to a standstill.

This has frequently been the experience, and in one case, which was recently reported to us, the inspector stated that a car was going nearly 35 miles an hour on the down grade before the driver attempted to reverse his machine; but when he did reverse it, he brought his car to a standstill with the loss of only one gear. Making due allowance for the possible excitement of the inspector, I think the car was moving at least 25 miles an hour when the reversal took place.

The riding of an electric car is unquestionably easier than on the majority of cable or horse cars, starting and stopping more easily, and being in a very large measure free from oscillation. It is scarcely necessary to say that the cars are cleaner, that they are brilliantly lighted, and that it would be possible even to heat them by electricity. The sanitary conditions are entirely altered, and the health and comfort of the people conserved by doing away with stables, with all their unsavory characteristics and resultant injury to the value of adjacent real estate. Branch lines of every possible combination of grade, curve and ill-conditioned street, which has so often proved prohibitory to any other system of propulsion, have been operated by the electric system. Distances up to six miles or more away from a single station have been operated without difficulty, and large numbers of cars from one station. It can very properly be said that there have been many breakdowns; that machines have depreciated; that there have been exasperating troubles. True, these things have happened, and in case of defective workmanship and of careless inspection or management, they will happen again, no matter what system of propulsion is adopted. The accidents which can happen to a motor come within a very limited category, and the liability of a motor to these accidents is being very rapidly reduced to a minimum, till it is becoming to-day the most perfect piece of machinery, capable of the longest continued use and a large amount of abuse. The very accidents which have happened, as simple as the causes are—and I may say here that nine-tenths of electrical troubles are due to mechanical defects—and the very makeshifts which have been temporarily resorted to to overcome the troubles and keep the lines in operation, are the best evidence of the flexibility of the system and the perfection to which it will arrive. No other machine in existence has, in so short a period of development, been brought to such a degree of perfection, is capable of such varied application, and can be so quickly and easily understood.

The cost of operation has proved entirely satisfactory, and my early claim has been substantiated. In a paper read before the American Institute of Electrical Engineers, in August, 1888, and also in some earlier communications, I made an estimate as to the expense of operating a 30 car road, dividing these operating expenses under two heads; (1) Those belonging to the central station; and (2) what may be called the road operating expenses, the sum of the two constituting the total cost of motive power. In taking this estimate I used extra care, and while preserving its accuracy, made every reasonable allowance that I thought necessary. The conclusion at which I arrived in the estimate under the conditions there given, was that the total cost of motive per car mile should not exceed $4\frac{8}{10}$ cents; and this included

everything except executive and salary expenses, taxes and insurance, and other matter not connected with motive power. I also stated that this was about 40 per cent. of the cost of operating by horses for the same mileage, and under the same conditions. My estimate was then considered altogether too liberal in favor of electricity. Without going into details, I may state that the most reliable possible records of roads, under every possible condition of service, bear out the claims that I then made as to the economical operation by electricity. I have the records of only a portion of the roads which we have equipped. Some roads see fit to make public these records. Others, and with a good show of reason, do not care to do so, because of the feeling that municipal bodies, in considering the granting of franchises, will not look at the increased cost of investment, but ignoring the manifold advantages to be gained by the introduction of electricity, for the public as well as for the company, are inclined to make unreasonable demands in the way of the reduction of fares, or require unnecessary and unprofitable extensions of lines. They forget that the reduction of one cent in a fare, means a cut on 20 per cent. in the receipts of the company, and that a very remarkable saving of expenses must be made in order to meet this reduction of revenue; especially where there is an increased equipment on which interest must be earned. But suffice it to say, that careful investigation will convince any candid man that the economic claim has been entirely supported, and the best elements of it is in the rapid adoption of this method of propulsion.

A few remarks may be in place relating to the interferences with other established interests, which this new application of electricity has developed. Such conflicts, as electricity is applied to different industries, necessarily arise and result from the claims made by two or three enterprises to the same area of occupancy, whether of air or earth. There have been, long before electric railways became at all common, conflicts of a more or less limited nature between the electric lighting and telephone interests. In the early days of electric lighting, and more particularly in that branch known as constant potential distribution, an attempt was made to use the earth for one-half of the circuit, precisely as was done and as has been done for years in telegraphy. Practical experience, however, demonstrated that this was a mistake where incandescent lights were concerned, and it is manifestly a mistake where arc lights and high potentials are used. The objections on the constant potential incandescent circuit were pertinent because of the liability of fire in the buildings where the ground circuit was used, and the element of personal danger very quickly put an end to an attempt to use a ground circuit for an arc light system. The same cautionary reasons applicable to these two classes of industries do not, however, apply to overhead electric railway systems. The electric railway circuit is purely an external circuit. Its derivations are through the cars which it supplies. It is led into no dwelling; its fixtures are not within the ordinary reach of any being. It is carried in the open air, in full view, in the most direct possible lines, and with only such supports as are necessary to make its construction safe, and to keep it in alignment. The whole construction of an overhead electrical system is

materially simplified, and in my opinion made, mechanically as well as electrically, far safer by the adoption of a single wire, using the rails as a return circuit. The practical proof of the wisdom in this decision is the fact, that about 90 per cent. of all the electric railways, either in operation, construction or under contract, in the United States, use only the single wire underneath contact. It scarcely seems necessary at this stage to go into the defense of this system. Its simplicity, the lightness of construction, the symmetry of outline, the size and strength of the poles, the fewness of the supports, the simplicity of all curve work, turnouts, crossings and sidings, and especially of all switch work and switch operations, are so manifest that elaboration of these features is unnecessary.

The use of the grounded circuit has unquestionably interfered with another and widespread application of the use of electricity, and that is the operation of telephones which likewise use the grounded circuit. So long as electric railways were in an experimental stage, running perhaps in suburban districts, out of the way of telephone circuits, little or no attention was paid by telephone companies to their existence. The strides which have been made in the past two years and a half, bringing the railway system into the very heart of towns and cities, and into the forefront as a commercial enterprise, and the rapid increase in the extent and use of the telephone system, have brought the two interests in direct conflict, which conflict is solely because of their common use of that great reservoir of electricity, if we choose so to term it, or rather that great common medium for conducting it which has been used alike by railways, telephones and telegraphs since these industries were started.

The claim of the telephone companies, in brief, is that by right of prior occupation and of their vested interests, no electric railway or other circuit shall so use the earth if interfering with their lines in any way. Their claim is far-reaching; it is of the broadest possible character, and, strictly interpreted, is an exclusive claim on the use of the earth for transmitting energy by electricity. That there is an interference with the telephone circuits by an electric railway circuit is undeniable, and the interference is one which is annoying. The character of the interference is twofold. Part of the trouble arises from induction, that sympathetic response in the telephone circuit to any changes in the electrical condition of the railway circuit, and part to leakage, caused by the diverting through the telephone system of a part of the current which has been discharged into the earth and is on its way back to the central station.

The relative amount of these two interferences has been variously stated. On the part of the telephone company it is admitted that conduction or leakage is a source of trouble. They also admit that the use of any metallic return circuit, it matters not what, whether it be an individual circuit for each telephone or a common metallic return for all the telephones, will obviate this or most of it. Even this much is admitted by the telephone interests with a great deal of hesitation, despite its perfectly apparent truth. But they go further. They claim that this is not the principal cause of

trouble, but that most of it is due to induction, and that if a return metallic circuit overhead were put up by the railway company—that is, if a double trolley system were used—then the telephone troubles would all cease. The various attempts they have made in the courts have been with a view to either compelling the railway companies to cease operations or to so change and erect their entire system as to abolish the use of the single trolley and erect in its place the double trolley system, or, on the other hand, to compel the electric railway company to pay for the necessary changes required in the telephone circuit to avoid the interference. No sooner was this issue presented, than it was promptly met by the railway interests which I represent.

Now, what are the facts? First, as I have stated, there is unquestionably an interference between the electric railway and the telephone services; but of the character of this interference it seems to me that no intelligent man who honestly makes an investigation, seeking truth, and truth only, and unbiased by the commercial interests which have retained him, can have any reasonable doubt. The assertions made by the telephone interests leave little room for exaggeration on their part. Not only has the character of the interference been misrepresented, but the costs of any changes made necessary on the part of the telephone company to avoid trouble, or on the part of the railway company to change over its system, have been grossly misstated.

As a matter of fact, the trouble from induction is of the very slightest character, and that must be patent to any one who is familiar with this particular electrical action. Generally the trolley wire is situated in the middle of the street, anywhere from 20 to 30 or 40 feet away from the telephone lines. It rarely runs parallel to them except for a comparatively short distance, possibly two, or even three miles, but more often less. The current used upon this wire is not of that character which distinguishes some of the arc light circuits, but is of more or less even flow, and the abrupt and large changes due to change of load on the motor, are comparatively infrequent. There is a very small change due to the variation of resistance of the armature of the motor, because of the different relative positions of the commutator blocks under the brushes, and there is likewise a variation due to the slight but rapid changes of counter electromotive force set up by the motor when running. But although these changes can be detected inductively, provided the conditions are favorable—for instance, if both the telephone and railway circuits were wound around a common bar of iron—the character of the disturbance is not so serious as to preclude conversation. But the trouble which does really become pronounced is that which is due to the actual difference of potential which exists on different parts of the track circuit—in other words, at the terminals of the grounded telephone circuits. There is discharged into the earth, as I have pointed out, a slightly varying current. It may be at some point considerably removed from the station and in close proximity to the ground terminal of a telephone whose exchange is likewise grounded at another point much nearer, electrically, to the station than the

point of discharge. The current reaching the rail has to travel back to the station, partly by the rails and partly by the earth. Both offer more or less resistance, and there is an actual difference of potential between the point of discharge and the station, rising at times to as much as 20 or 30 volts; but it is, of course, a variable potential, and the current which flows over that path is one which varies in its character. Having discharged the current in the earth, there is absolutely no limit to its diffusion. We desire, of course, that it should return by the rails, but no boundary can be placed upon it. A part of it goes through the rails, but some portions will go through the earth, through water ways, mineral veins, gas and water connections, electric light tubes, telephone circuits, rivers and canals, and, in fact, over any and all paths which offer it opportunity to return to the source from which it originated. The shortest geographical line between two points may be 1,000 feet. The paths of the current between those two points may be anything from 1,000 feet to 50,000 or more. But precisely as the rail current is thus disseminated or diffused in its return paths, so also is the telephone current. True, it is only a current of small capacity, so small as to interfere with no other enterprise or translating device except others of like character, but its diffusion is of precisely the same character and over the same territory and through the same classes of conductors as that of the rail current. Could the telephone current be limited in its path, and the claim of the telephone company be narrowed down to a specific section of earth, then, possibly, there might be some basis for a claim to the use of that section; but such a restriction is, of course, manifestly impossible. Hence, any claim the telephone interest makes to the earth must be vague; it must be all-reaching, it must be exclusive. It would seem that it has no more legal right to make a claim which prohibits a railway in the town in which the telephone circuits are operated from using the earth, than it has to make a claim that a railway in any other city with which the telephone may be remotely connected, shall be prohibited likewise from using the earth in that particular city, although it may be 100 miles off. It is a well known fact among electricians, and probably no better known than among the telephone people themselves, that, perfectly independent of railway enterprises, a far better service can be rendered the patrons of the telephone where a complete metallic circuit is used and the use of the earth abolished. The telephone is the most jealous detector possible of all disturbances of electrical conditions on the circuit which includes it. Its very function as a transmitter of speech depends upon this marvelous delicacy. As now operated in the majority of telephone exchanges, it is subjected to continual interference, not only from the railway circuit, but from every electric light, power or telegraph with which it is brought into proximity. It is subject to interference from atmospheric changes and discharges. The telephone circuits themselves interfere with each other. Cross talk and false signaling are common. Almost all these troubles can be avoided, and the telephone service made far more perfect by using either the individual metallic return with the switchboard properly constructed for it, or the individual return, the return wires

coming to a common terminus, which would make absolutely no change in the telephonic switchboard; or what has become known as the McClure device, the use of an artificial metallic ground or common metallic return—that is, by breaking the ground connections of the individual telephones and connecting them all to one common copper return of a resistance which shall be low compared with the resistance of the instruments themselves. The lower the resistance of this common return, the less interference of the telephones with each other. The cost of this latter method is a bagatelle. It should be put up by the telephone companies for the sake of their patrons, independent of whatever other electrical enterprise they may be brought in contact with. Wherever intelligently put up, the relief from outside interference has been almost absolute, and the testimony of parties who made complaint when telephone companies first sought to obtain an injunction against the railways, is now emphatic as to the relief which has been obtained by this change in the method of running the telephone circuits. It is unquestionable that the telephone company is waging the warfare from the standpoint of economy, pleading the rights of vested interests, notwithstanding every telephone expert knows the great advantage to be gained from a metallic circuit, and notwithstanding the fact that sundry papers read at the telephone conventions not only admit that the metallic circuit is best, but give testimony from the exchange superintendents that wherever their patrons once use the metallic circuit and long distance telephone, they are never satisfied thereafter to use the grounded circuit. It is likewise suggestive that the Bell Telephone Company to-day advertises no less than about 150 local stations in New York City equipped with the long distance telephone and the metallic circuit. Since there is not an electric railway in the City of New York, their action in this locality could not have been dictated by interference from that interest.

The position, from a legal standpoint, seems to be something as follows: As between telephone and electric light and power companies there may be a question concerning respective rights, because the electric light and telephone companies may both occupy the highway as of equal dignity. But even in such a case neither one of the interests can have just right to an injunction, because the proper way of redress is a suit at law to determine the amount of damages for which the one party is liable on account of a violation of the other's rights, permanent injunction being granted, I believe, only where the troubles are irremediable, or where the damage cannot be readily computed. Wherever the telephone, however, seeks to trammel electric railways in their free use of the public highways, and especially where they have been granted the right of such use, an entirely different question is presented. The public highway was originally and primarily dedicated to public travel whether by foot, by horse or by vehicle, and for no other purpose. It was contended some years ago that street railways ought not to be allowed upon highways because they had tracks; but wherever courts have been called upon to make a decision, it has been held that street railways were but an improvement upon the old methods

of travel. It was even at one time questioned whether there might not be a distinction between the rights of a street railway, where the public owned the fee, and those in which the title was in private individuals, but even this distinction was not allowed. When electric railways were developed, an attempt was made to claim that they were a perversion of the highway; but it was then held that electric railways were an improvement only upon street railways propelled by horses or other motive power, and should occupy the highways with the same rights as were enjoyed by the street railways using the other motive power before electric propulsion was resorted to.

Since both the telephone and the railway companies occupy public streets by public license, it is, of course, necessary to examine into the source of their respective titles and the character of their occupancy, because otherwise it would be impossible to understand what are their respective rights. The electric railway has proven a great advance upon any method of street car propulsion hitherto known. It has been shown to be economical, safe and advantageous as a method of public travel. It certainly cannot be said to be objectionable *per se.* It interferes less with the travelers upon the highway than many other methods of propulsion and its very extended adoption shows us that it has been sanctioned by public authorities as a safe and proper method of travel. The single trolley system being used by nine-tenths of the street railways in the United States using electric motive power, as against all other methods. certainly shows that practical experience is in favor of that particular method. As an improvement upon the method of propulsion, it would seem that an electric street railway uses a public highway, occupies the same and enjoys the right of travel thereon, as of equal dignity with any or all other persons or vehicles upon that highway, and that this right of enjoyment is within the original purpose for which the highways were opened. On the other hand, it is pertinent to inquire what right or title a telephone company has in the street. By virtue of the original dedication of the highway they have no rights except that of toleration. Telephone and telegraphs are identical in contemplation of law, and have been held to be an additional burden upon highways. In almost every case where this question has come up in the matter of telegraphs, such has been the decision. The statutes under which telephone or telegraph lines are permitted to be erected on highways provide that while they may be so erected, the poles and wires shall not interfere with public travel upon the highways. Since this is true, the telephone companies are upon a public road not by virtue of right, but of toleration; not as the equals of the street railway, but subordinate to it. They occupy a secondary position, and this being the case, where conflict arises between the two, it would seem that the telephone interest must eventually yield, for its claim against any competitive enterprise is nothing less than a claim to the exclusive right of the earth, not to some section of it, because there are no limits to which the telephone wires may not reach, no boundaries to the portions of the earth which form a part of their circuits. Certainly no statute gives an exclusive privilege to a telegraph or a telephone company; and any claim for such an exclusive

right, to be substantiated, must show an express or implied grant from some source, and the boundary as well as the source of that title. Not only this, but it must show that the title is exclusive. In view of the fact that the telegraph companies had used ground circuits for 30 years or more before the telephone was discovered, and that patents were refused for such use, it will be somewhat difficult for the telephone company to show the source of its title; and it is manifestly impossible to show the limits of the territory from which any other enterprise must be excluded, so that it will in no way interfere with the operation of the telephone system, for the telephone circuits being attached to the gas and water systems of the community in which it is located, the ramifications of such systems and of all the subterranean electric conductors of the earth in contact with these metallic conductors are unknown to science. How other electric currents entering the earth may do so without invading the charmed area of the telephone and disturbing its grounded wires, no man can say, much less can the telephone people themselves. The boundaries, then, of their claim being so vague, it would seem that their claim itself must necessarily fail.

Within the past two years there have been, I believe, eight attempts made by the telephone interests to get an injunction. The first was in Akron, O., in the latter part of 1888, where the Central Union Telephone Company, of Chicago, attempted to restrain one of the Sprague roads by injunction. This was denied. The next suit was against the Harrisburg road and the Sprague Company by the Penn Telephone Company. A number of common stockholders, I believe, were interested in both companies, and although the attorneys of the railway companies were fully prepared and desirous of seeing the case brought to trial, the case was abandoned and compromised, for the very sensible reason that it would cost less on both sides to compromise than to carry it to the higher courts. The next attempt on the part of the telephone interests was in the application for an injunction against one of our roads at Chattanooga, Tenn. This injunction was denied. Then came a conflict in Salt Lake City, where many of the people were so interested that they said as between the telephone and electric railway interests, if the decision was against the railway company they would abolish the use of the telephone. Such heroic measures apparently were unnecessary, for the injunction was twice denied. Then application for an injunction was made in Cincinnati—and this will probably become a cause of célèbre—for an injunction, on what ground I do not yet know, was granted, and the case will be carried to the higher courts.

In Eau Claire, Wisconsin, an attack was made on the railway interests under cover of a State law which the telephone companies had quietly gotten passed, requiring a return insulated conductor for any circuit carrying electric energy. The injunction was there denied, for the telephone company had somewhat overreached itself, and found itself quite as much in the mud as the railway company might be in the mire, so far as the law was concerned, because they were themselves the carriers of electric energy and were using grounded circuits, and, consequently, had no standing before the court. The

last case with which we have been directly concerned is one at St. Joseph, which has not yet been tried. In Albany, where another electric railway company is operating, the telephone interest has succeeded in getting a temporary injunction. I believe this case, in which my own company is not particularly interested, except sympathetically, has been recently reheard and a decision on the merits is now pending.

With the records thus given, it would seem that the electric railway companies have little to fear from the attacks made upon them by the Bell Telephone Company. They are well within their right, and that being so, their position must sooner or later be established beyond all peradventure. The cases which I have enumerated are not the only cases in which there have been interferences between the electric railway and the telephone; but in almost all others, both the railway and telephone companies have recognized each other's moral, if not legal, rights. Often the same stockholders have been in both companies, and a sensible compromise had been effected, in which the telephone company has sometimes changed the route of its circuits, or put up a common return, or the companies have used each other's poles, and a just division of expense has been settled upon. This would seem to me to be the better plan wherever conflicting interests arise, and is one which I would recommend in all cases where the telephone companies are willing to recognize the justice of the legal position of the railway company, instead of attempting, as they have in the cases mentioned, to deny that right. A just compromise, but no surrender, should be the motto of the railway company.

So much for street car practice, and looking forward we naturally ask what will be the near future of the application of this remarkable agent? Already we have gone from one car units to trains of two, three, and even four cars in the street, and four cars have been operated from a single station. The next step will be the operation of some of the cable roads, then systems like the Underground Railway of London, the Elevated Railways of New York, the Brooklyn Bridge system, and then suburban lines will be operated. But is this the limit?

I have been frequently asked whether, in my opinion, electricity will ever be used on trunk lines for through passenger or freight traffic? My answer is: Probably not, according to present notions of trunk line transportation, and not by present methods of train dispatching. But in these qualifications I admit my hope and expectation of rapid transit under certain conditions. Let us for a moment consider a few facts.

Railway managers are constantly meeting with a demand for more rapid and luxurious methods of transit, and every effort which executive ability and financial expenditure within reason can devise, is made to meet this demand. I think I can safely say that as steam railways are operated, a maximum speed of 90 miles per hour, and a running speed of 60 to 70, is all that can be hoped for in steam railway travel, under the best conditions which can be provided. The limitations are too many. The maximum speed made by a locomotive, to-day, is but little more than was made 20 years

ago. True, engines are larger and more powerful, but the increased weight of trains has made this necessary. To get pulling power there is a limit to the size of the drivers, and whatever their size there is a limit to the economical rate of piston speed, and to the number of revolutions per minute. As the size of the driver increases, the center of gravity of the engine is raised. As the steam demands become greater, the difficulty of taking water and of firing grows more pronounced. Even now it requires the best work of a fireman, when his engine is pulling a heavy load, to prevent the engine dying on the road, or at least falling far short of its duty. The increase of running speed has been obtained principally by cutting down grades, straightening curves, filling up ravines, replacing wooden structures by permanent way of iron or stone, the use of heavier rails, safer switches, improved methods of signaling, the interlocking switch and signal system, road crossing gates, the abolishing of grade crossings; in short, by improvements in detail and management, which permit a higher safe speed over a more extended section of road, because of greater intrinsic safety, and of the greater degree of confidence inspired in engine driver, rather than by marked advance in the speed capacity, which should not be confounded with the pulling capacity of the engine *per se*.

With respect to electric motors, the question is not now if a motor of sufficient capacity be built, or efficiently and positively controlled, but rather how can the electricity be produced and supplied to the motor, and at what potential can we work? We all hope to see the time when electricity can be produced economically from coal without the intervention of engines or dynamos; and it may be that something akin to the present steam practice will be common; but I think that even then it will be quite likely that a central method of distribution will be the more advantageous. On the other hand, there are those who hope to see the storage battery so reduced in weight and improved in other particulars as to warrant its use in a large way in locomotives. For myself, I prefer to consider the possibilities of another method, the amplification and development to its full capacity of the present street railway practice, and for that purpose I will briefly consider a supposititious case, namely an express between New York, or rather Jersey City, and Philadelphia. But before considering this problem, let me point out a feature or two about steam roads. When first laid through a new country they usually consist of a single track, which must do the manifold duty of providing for through and local freight, and local and express passenger traffic in both directions, with what success those who are called upon to travel in new countries are well acquainted. The route of such a road is determined mainly with the idea of getting from one place to another by a more or less direct route, but especially one which shall not require too costly construction. Once determined, new towns spring up along the line of the road, and old towns grow until the demand of traffic make a double track necessary. As civilization grows apace, the freight traffic demands a track by itself, and four tracks constitute the equipment. So, following the development of the road, we will find that in time the express and local

passenger trains may require individual tracks, and a six-track road will be a necessity. But it must be borne in mind that the express is not intended to cater to local travel, but its route is subordinated, both in the matter of curves, grades and crossings, to the requirements of the early construction. The highest demands of such a service would require that, independently of the local travel, a through express track should be constructed by the most direct route possible between the principal localities, and every effort made to reduce the curvature and grades as much as possible. No matter how much it costs to build such a road, when the traffic is sufficiently large, it will pay to do it.

Suppose such a road to be an electrical one, and the method of supply to be from one or more central stations, the current being taken by a universally flexible underneath contact from a rod carried above the car, and the return circuit made by means of the rails. This method, using, of course, a wire instead of a rod, having been almost universally adopted wherever street cars are propelled by electricity, its characteristics are well known. What the structure of the roadbed would be need not here concern us. We might use the standard T-rail and roadbed, avoiding as much as possible curves, grades and grade crossings, and the overhead rod can be used simply for supplying the current; or some form of a double or single track road slightly raised above the ordinary level, and with the upper rod forming a steadying and centering chord as well as a current supplier, may be used. These are mechanical questions with which we need not concern ourselves at present. What does concern us, however, as electrical engineers, is whether the cost of copper, the potential required, the losses on the line and the number of stations are such as would be prohibitory.

As regards the potential, other things being satisfactory, whatever pressure is demanded in the interest of economical and effective service will be used, and means will be found, consisting mainly in construction of cars, which will make its use for the purposes, and, as intended, safe and proper. We have, in these matters, to face the same questions that we have in the matter of steam pressure, or of railway speed. To accomplish the larger engineering feats necessary to meet the demands of economy and commerce, we will be governed more by belief in our power to fully subordinate a good servant to our will than by our fears of its vagaries when allowed to become a master.

From 8 A. M. to 9 P. M., a period of 13 hours, 21 regular trains leave the Jersey City station of the Pennsylvania Road to run through to Philadelphia. Twelve of these make but one or two stops. The balance make more or less stops according to the running schedule. In addition to these, there are a number of local trains serving way stations. Taking the through trains only, and allowing an average of, say, five cars to a train, there are in the 13 hours about 105 through cars dispatched from Jersey City, or at the rate of one car every 7½ minutes, and of the through cars not making over one or two stops, there would be one every 13 minutes. We will suppose an additional express track has been built, leaving the distance about what it is now, say, 90 miles, but that the grades have been eased and the worst curves rectified. For the practical purposes of this paper I will consider that the road is level,

that the cars are to be dispatched in two-car units on a perfect block system, and to run through to Philadelphia with not more than one stop, at fixed intervals, and at a high average rate of speed, say, 60 miles per hour. In the systems that I would propose—practically that with which I experimented some years ago—slight grades would make little difference in the general result, especially if the grade percentage, expressed as a whole number, does not exceed the quotient of the traction in pounds per ton divided by 20; because when $c = \frac{t}{20}$, where t equals tractions in pounds per net ton, and c equals grade percentage expressed as a whole number, the work of traction and of lifting are equal. For example, suppose $t = 10$ pounds and $c = \frac{1}{2}$ per cent., and that we had on a double track one unit coming down the grade and the other ascending it, both at the same speed. Then gravity would be supplying just enough power to propel the car on the down grade at a fixed speed, and enough power to supply the lifting and traction work of the other car would have to be supplied, which would be just the amount required to propel both cars on a dead level.

Suppose the grade to exceed the ratio expressed above, then the car on the down grade would have an excess of falling energy, and this would be used in accelerating the speed of the car, or on the brakes, or it could be used by a process of reconversion for the purpose of supplying at short range part of the extra energy required by the ascending train. Just how this can be done is pretty fairly understood by electricians, but I will touch upon it again, because it is a feature of vital importance in determining the matter of motor control in a large system such as we are now considering, and because it illustrates one of the most beautiful features of this method of converting energy. No matter whether a machine be used for a motor or a dynamo, whether to convert mechanical energy into electricity or the reverse, the armature develops an electric pressure or potential which is dependent upon its speed and the effective strength of the magnetic field in which it is used. If this field is in shunt relation to the armature and in connection with the track circuit, we have, by any of the well-known methods, a means for independently varying the strength of that field. When such a machine is geared to a car, it can either drive the car, acting as a motor, or be driven by it as a dynamo, and in connection with any other similarly connected motor, or the central station generators, will form an electrical couple, either of which may be driven by, or drive, the apparatus to which it is connected. If the couple thus established is between the motor and the central station dynamo, we have at one end a machine driven by a constant speed engine and generating an approximately constant electromotive force, and at the other end a machine of greatly varying speed, and with facility for increasing or diminishing the electromotive force which it generates. The result is an electrical differential which will establish a current between the two in one direction or the other, according as the pressure developed by the motor is lower or greater than that developed at the generating station. If the pressures are equal, no current will flow between them. If the couple consists of

two motors thus connected, then we have two apparatus, each of which is generating a variable electromotive force, and there will be a current between these or not, according to their relative electrical pressures. A large system is tied together in the most intimate manner possible. The tracks are cross-connected, the overhead conductors cross-connected, and we would have, in effect, what would correspond to two large planes, between which is moved at varying speeds a number of independent units, these two planes being kept at a fairly constant potential by means of the generating station. All motors starting, running on a level, or ascending a grade, would be requiring current. All motors running on a down grade with just that velocity which the force of gravity would give them, would require no current; and motors running on down grades of greater percentage than is required to give them power for traction, or motors slowing down, would be generating currents to aid in the general supply. No other system of distribution can by any possibility have this very remarkable interchange of energy. When running at a particular speed, a slight movement of a regulating handle would make the motor receive from or give to the line currents in any desired quantity. The braking power of a motor thus acting as a generator is very powerful and the most perfect imaginable, because, unlike the ordinary methods, the brake does not operate if the wheels stand still, the very essential of the braking operation requiring the wheels to turn. It is a well known fact that the most effective brake work is when the wheels do not skid upon the track, but when they are turning under the pressure of the brake; and contrary to the ordinary braking practice, the energy of the electric train, instead of being thrown away in the form of heat and using up the wheels and brakeshoes, can be made useful in the propulsion of other trains. I have tried this method of braking with such a degree of refinement that a heavily loaded car would creep on a down grade at a pace so slow that that an egg could be put under the wheels and cracked and removed before the wheel would pass over it.

Having thus touched upon the characteristics such as I would propose for a railway system of this character, let us resume the consideration of the proposed line between New York and Philadelphia, and try to form some idea of the electrical pressure which would be required, the service which could be demanded, the number of cars which could be handled, the speeds which could be maintained, and the number of stations which would be required to operate the stations. We will assume, for the purpose of this investigation, an overhead conductor in the form of a solid rod one inch in diameter over each track, or, if you please, a smaller rod over each track, and a main conductor making up on equal weight, and a track of equivalent capacity. I take this arbitrary size because it is convenient for the purposes of our calculations and because it falls well within the limit of expenditure which such a system would warrant. For instance, the American Bell Telephone Company has a line of long distance telephone wires running from New York to Boston, a distance of about 300 miles, nearly three and a half times the distance which we are considering. On these poles are about

70 wires each of No. 12 copper. The aggregate area of these conductors is over 800,000 circular mils, and the total weight of copper on this line, which is used simply for telephonic purposes, is about 40 per cent. more than the weight of two copper rods an inch in diameter running from New York to Philadelphia. If the investment is a reasonable one in the telephone system, cannot we certainly consider it a reasonable one in that larger field of the transmission of power of which we are now speaking.

As I have stated, of the number of trains which in 13 hours leave Jersey City for Philadelphia, 12 usually make only one or two stops. Allowing 60 cars, this would be about one car every 13 minutes. This interval of 13 minutes is nearly as short as would be desirable between cars running at an average speed of a mile a minute, no matter how perfect the block system, and it would be necessary to run these cars in double car units. We will assume for our purposes the size of a car such as is used on the elevated road in New York or the Brooklyn Bridge, which would, with motor and passengers, weigh from 20 to 25 tons, or a total of, say, 50 tons for our unit. The formula to determine the size of conductor for a single transmission of car is:

$$cm = \frac{15,666\, n\, l}{E\, v\, \varphi}$$

where n = the number of horse-power, l = the distance in feet, E the potential at the motor, v the fall in potential and φ the commercial efficiency of the motor. If we assume the station situated in the middle of a line, that is, at the best point, and the work divided equally at the middle section on each side, then l being the length of line. we have the formula:

$$cm = \frac{15,666\, n\, L}{4\, E\, v\, \varphi}$$

This will be practically the same if the work is distributed over the entire line.

If more than one station is used, then the formula will become

$$cm = \frac{15,666\, n\, L}{4\, E\, v\, \varphi\, S^2}$$

that is, the size of the conductor would vary inversely as the square of the number of stations, if properly distributed; v may be expressed as a fraction of E, and for practical purposes we will let $v = \frac{1}{4}$ of E, and φ such that

$$\frac{15,666}{\varphi} = 16,800,$$

that is, φ = about 93 per cent. Then we have

$$cm = \frac{37,800\, n\, L}{E^2\, S^2}$$

which may be expressed thus, that the size of the wire varies inversely as the square of the product of the number of stations and the electromotive force.

We may also note that with any fixed size of conductor the electromotive force and the number of stations vary inversely—a somewhat important fact to remember.

We have another formula, one for the power required by a moving car, which is

$$hp = \frac{4}{75} w m \left[c + \frac{t}{20} \right]$$

where w = the weight in net tons; m, the miles per hour; c, the percentage of grade expressed as a whole number, and t, the traction in pounds per net ton.

As I have stated, we will assume in this formula that c equals zero, a consideration in which I am justified in express service on a road of the character I have outlined, with the relation of grades and traction given, and with the method of braking I have described. Our formula would then become, using 10 lbs. per ton as our average traction,

$$hp = \frac{2}{75} w m$$

which, substituted for n in the distribution formula, gives us

$$cm = \frac{1{,}008\ w\ m\ L}{E^2\ S^2}.$$

or substituting for L, 5,280 d, d being the number of miles between stations,

$$cm = \frac{5{,}322{,}240\ w\ m\ L}{E^2\ S^2}$$

we have assumed for our conductors two rods an inch in diameter, and that the rail has the same resistance. Hence, substituting for c. m. its value, 2,000,000, we have

$$E = \frac{2.66112\ w\ m\ d}{S^2}$$

or

$$E = \frac{1.631}{S}\sqrt{w\ m\ d}$$

It will be noted that m, w and d, that is, number of miles per hour, weight handled and distance over which operated, are all affected in the same way. Hence, with any value of E and S we can vary the relative values of w, m and d, so long as we do not disturb the product. That is, we can halve the number of miles and double the speed, or double the distance and halve the running the speed, keeping the weight hauled the same, and so on. For w, the total weight, we can substitute the weight of each unit, c, and the number of units, b, thus making the formula

$$E = \frac{1.631}{S}\sqrt{m\ b\ c\ d}$$

For the line proposed, $d = 90$ and we have

$$E = \frac{15.56}{S}\sqrt{m\ b\ c}$$

Taking our unit of two cars at 50 tons, the time intervals between them at

ten minutes, and 60 miles per hour as the mean speed, we have on the whole system 18 active units of two cars each, and $m\ b\ c = 54,000$, which, substituted in our formula, gives

$$E = \frac{3,615}{S}$$

which means that with one station in the middle, the potential at the most or farthest from the station would be 3,616 volts, and near the station one-ninth higher. Can we handle it? Yes, in time, but perhaps not yet. Nor is there any necessity for doing so; for if we increase the number of stations and go to a three-wire, instead of a two-wire system, making the track the balance of circuit, we would have the motor potential as expressed by the following table:

Stations		Motor Potential	
Number.	Miles apart.	2-wire.	3-wire.
1	....	3516	1808
2	45	1808	904
3	30	1205	603
4	22½	904	452

which last brings us down to ordinary street car practice, which is only the beginning of what will be done in the effective handling of potentials.

So, after all, it does not seem such a serious electrical problem, and certainly not one to shrink from.

We can in another way illustrate the influence of the position and number of stations and the potential used. Suppose we had a station at Jersey City to supply the entire line at a certain potential over a conductor of the required size. If the station be moved to the center, the weight of copper necessary is only one-quarter. Use two stations properly spaced and the weight is quartered again. Double the potential and the weight is further quartered. Now use the three-wire system and the weight is again quartered. So that by these very simple processes the original weight has been reduced $\frac{1}{256}$ of the original.

I don't think I need to point out further the use of a proper determination of electrical values in a problem of this character.

We see, then, that the supposititious case is well within the range of possibilities. A 60-mile express service every 10 minutes instead of a 40 to 45-mile service every hour would revolutionize travel. Of the comforts of such a system, I need not speak. That it will in the not very distant future be a fact, I know you all agree with me in hoping.

When Mr. Sprague closed his address, the Convention saluted him with a hearty round of applause.

Judge Armstrong: I do not mean to undertake to discuss the paper. I am interested in electric lights. We have made a contract with a street railroad company in our city, in which I am also interested, to supply it with power. I did not want to

stay over to-day, but my general manager insisted that I should. I did stay, and I have been amply rewarded for it. I want personally to thank Mr. Sprague for one of the most intensely interesting papers to which I ever listened. The figures that he has given us, the explanations that he has made, and the statements throughout his address have been to me of the most intense interest. I was pleased with the legal position he took. As a lawyer, I must commend him as a very good lawyer. (Laughter and applause.) Some of the matters he has stated were novel to me in the statement of them, but he stated such general principles that I had to say I knew it all the time, but didn't think of it. (Laughter and applause.) You know it is a very wise man that will tell you things that you knew all the while, but hadn't hold of the ends of it. I think I will have to send him a sort of retainer, because he has given me, outside of electric light, outside of any such connection as this, an idea relative to some legal troubles we have with our street railroad; so I am particularly obliged to him on that account. I owe him a further obligation for what he has given us as to the increase in the use of electric power, the possibilities that he has opened to us by pushing the door a little aside. Personally, I am obliged to him, and, as an Association, we ought to be obliged to him, as central station men who are creating this wonderful power, who have it for sale, who wish to send it out; and I am sure the rest of the members of the Association want to say to Mr. Sprague that we appreciate very greatly this wonderfully interesting and wonderfully able paper. (Applause.)

Mr. Sprague: I do not know that my modesty will allow me to thank you for the compliment to my legal ability. (Applause.) I think the amount of your retainer ought to be turned over to Mr. John S. Wise, the counsel of our company, whose pupil I have been in that matter. It is more a statement of his position than of mine, in several suits. I asked him to explain the matter to me, and on his doing so I tried to put it in my own phraseology as well as I could. You have touched upon a subject which is an important one, certainly to those who are managers of electric light stations, when they are called upon to supply the power for electric railways.

The amount of power used, of course, depends upon the

amount of traffic, the number of cars run, the schedule, the intervals between the cars, the grades—in fact, there are a great many questions which determine it. But we have very recently had an investigation made on five roads, embracing every possible condition, and in a short time these will be published in detail, and the results will be interesting to you as central station operators. All these figures will be very exact, and they may be useful in determining the contracts which are sometimes entered into between electric railway companies and electric lighting associations.

The cost of operation of railways is very much less than we have claimed. Whenever we have asked the railway companies to give us this cost, they reply: "Well, when we were in the early stages of this business it was necessary to bring us to a satisfactory condition of mind to sign a contract—it was different then. We find there are a great many elements of economy, now we have gotten there, and we would be glad if you would keep that out of sight, do not publish it broadcast, because we do not want some legislative body to come down on us and say, 'Reduce your fares to four cents, or sell seven or eight tickets for 20 cents.'" So we have had, commercially speaking, to accede to that request. There will be gradually, in many of our cities, an amalgamation of the electric light and railway interests. It seems to me that is the natural outcome, and I know that oftentimes the same stockholders are interested in both the electric light and railway companies. I am going to have, very soon, in a little town in South Carolina, what I think is the most complete electrical station in the United States. Some associates and myself being convinced that not only the electric light but the electric railway business was a good thing, from the experience we have had with it in the past two years, got hold of an electric lighting company that was earning a very reasonable dividend on its cost. They had an electric railway franchise which was exclusive for 30 years, and which had been granted both by municipal and legislative action. They also had the general railroad privileges of condemning public and private property. Their rights being exclusive not only in the two towns, but for the vicinity, for 30 years, and there being no railroad, no gas company, we thought the opportunity was an

excellent one to carry out that idea which is always in the minds of electrical people, namely, the consolidating of electrical interests. We not only consolidate the electric part of it, but we consolidate the elements of management and *personnel.* We have different systems, the arc light system, the incandescent system, the power circuit and the railway circuit, all in the same building and under the same roof as the car sheds, and, with all respect to the telephone interest, I think pretty soon we will have the telephone circuit; we wish to run telephone wires on the same poles with the others. We are going to demonstrate that it is quite possible to run a telephone circuit and an electric railway line not only in conjunction with it, but in conjunction with arc lights and incandescent lamps. We hope this enterprise will be profitable, and that there may be a great many other places in which the same thing can be done.

MR. DE CAMP: I would like to ask the gentleman, when he gets that arrangement consummated, whether he is going to put that forth to the world? If he is, I would simply say, don't. I would also like to know, when he gets through, who is going to own that town?

MR. SPRAGUE: As between yourself and me, Mr. De Camp, I hope we will. So far as the cost is concerned, we will make that more or less public, I think. We shall not claim that the economy is due entirely to railway operation, but we shall show that simply because the same boilers are supplying energy for all the purposes, that is the reason for the good results.

PROFESSOR EATON (of Liberty College): I would like to ask Mr. Sprague if he has any objection to stating what his principal reasons are for his conclusion that the storage battery system will not successfully compete with the overhead or direct wire system?

MR. SPRAGUE: It is this: The simple reason is that you cannot three times convert energy at the same economy that you can once. That is the first reason. Secondly, because you cannot carry a dead load of two tons around, necessarily or otherwise, without energy. You have got to carry your storage battery, and you cannot get rid of that useless load. It weighs nearly two tons. It weighs as much as 35 or 40 passengers. It weighs more than your motor equipment; it weighs more than

your car body considered by itself; it weighs more than your iron trucks considered by themselves. We have to carry our motors around, we have to carry the trucks, the passengers and the car bodies; but to carry our storage battery is another thing. There are no storage battery equipments in existence; furthermore, whose storage capacity will permit of more than 25 or 30 horse-power being taken out of them? If you limit the weight of size of your battery, you reduce its capacity. On grades of 10 or 12 per cent., and that is about the maximum which the adhesion of the rail will permit, you will need about 30 horse-power of mechanical energy, and the motor has got to develop that. There is no storage battery that you can put on a 16-foot grade to-day, out of which you can take power for 30 minutes at a time; the capacity is not there. But when you get the over-head line or the underground conductor, provided it is connected with a big engine and a lot of dynamos at the other end, you can demand from that station all your motor can carry. There is no storage battery in existence in the United States, which a storage battery company dare recommend, that you can put upon a six per cent. grade and operate it, or that you could run a car 160, 170 or 180 miles a day. The maximum work of storage battery per car per day, is about 80 or, possibly, 90 miles, and there are very few cars doing that. There are no storage battery cars, that I am aware of, which are working 18, 19 or 20 hours a day, as is the case with the direct system of supply cars.

I hope, as cordially as any other man, that the storage battery is going to be a success; but there is no question but that its limitations are pretty clearly fixed, and that it can never compete with direct sources of supply. There is no limit to the capacity of the motor or the amount of current you can use from a direct source of supply. There is certainly a well defined narrow limit in the case of the storage battery. I say that with all friendliness to the storage battery, because I am interested financially in one—or, rather, I should say, one is financially interested in me.

The President: If there is no further discussion of these topics, with instructions to the Secretary to spread upon the minutes the report of the Committee and the interesting paper of Mr. Sprague, and the discussion thereon, we will pass the

topic. We will now receive from Mr. Haskins his paper on the subject of "Prodigality in Economy."

Mr. C. C. Haskins, of Illinois, then addressed the Convention on the subject of "Prodigality in Economy," as follows:

PRODIGALITY IN ECONOMY.

BY MR. C. C. HASKINS, OF CHICAGO.

The cautious man of business, when the dull season comes round, goes carefully over his past record, scans his methods, weighs his successes and failures, and endeavors to so arrange his future as to increase the former and, to the greatest possible extent, diminish the latter. If he finds that by a liberal expenditure of energy or money in some particular direction he has made satisfactory advance, he seriously considers whether more extended effort in that direction will not still further aid in the general result for which he is striving; and he as carefully passes by and ignores those plans and efforts which have proved either disastrous or very moderately successful.

There are times and occasions when such retrospective examinations of methods and systems are demanded by circumstances, and—as in religion and politics—a revival seems to be required to bring the record of the past up to the programme of the future, that the one may be used for the improvement of the other by direct comparison. In such a connection I have thought that possible good might result from canvassing the question whether there has not been in the past, whether there is not now, among the electrical fraternity, an inclination to practice a sort of delusive economy in many directions, a policy, which, to use an old and homely proverb, is "penny wise and pound foolish."

A few years ago, when the arc light was hardly more than a possibility, the fraternity, composed wholly of those whose electrical education had been acquired while handling nothing heavier than a quadruplex telegraph battery, brought such knowledge as then existed to the work. One line that I call to mind was put up with dry cotton covered wire—magnet wire—and the terminals of the line were carried to ground through the gas and water pipes. It was a commendable job, for the best was done with the knowledge at hand. Truth to tell, it would not have been a very dangerous affair if it had got away entirely, for it was a very small plant, and like many another nurseling, quite feeble. It was not long until the owner demanded an improved circuit, and again the best wire in the market was used. A second time the plant was overhauled, and the second wire was not considered good enough, but was substituted by one of the best rubber wires known to the trade. I should add that in each instance the plant, on being overhauled, was increased in size as well as improved in construction.

I once asked the owner of the property if the alterations and improvements in that plant were not very expensive. His answer showed me true economy in coal bills, wear and tear of engine and boiler, increased immunity from danger to person and property, and a better, both brighter and steadier

light at less cost, with less rebate bills and less unpleasant interviews with his patrons.

I have in mind a second plant, where it was deemed wise by the management to purchase everthing which could aid in tabulating expenditures, in the more readily handling the work to be done in the dynamo room, in the engine and boiler rooms, and in the office. No inconsiderable amount of money has been expended in the purchase of instruments for procuring the various data. Every pound of coal and every bushel of ashes is weighed, and the results are as carefully kept and as faithfully exact as those of a bank bookkeeper's balance sheet. The performances of the engines and dynamos are duly recorded for every day's run. The lines are measured, not only for insulation, but for copper resistance as well, and a record to the minutest particular is made up daily for the eye of the manager. The most minute leak is thus discovered in time to prevent a great waste, and is repaired before sunset if possible, so that no greater strain is set up when the dynamo is again set in motion. Since the first revolution of that engine there have been paid in repairs—renewals of parts damaged by electricity—less, during over twelve months' constant running, than on many a plant of one-quarter the capacity, is wasted in the item of oil alone.

A plant not unlike the one last mentioned, one in which all these vital matters are recorded daily, and tabulated for the manager's eye, has been cited to me as an example of what may be accomplished by a study of such information. In this plant there are fourteen dynamos in daily use, consuming an average of 1,900 pounds of coal per day. The record shows that of this there is about fifteen per cent. waste. The manager shows that he is using four and one-half pounds of coal per horse-power hour. And for the engines, shafting, dynamos, etc., one barrel of oil is consumed per month. I would gladly mention names in these cases were it not that my lips have been sealed by parties furnishing the information.

Oils for lubrication are as plenty as blackberries, and twelve cents, fifteen cents, twenty cents, per gallon has a fascination for him who searches for bargains in oil. An apt illustration of the economy of cheap oil was lately given in a railway publication. According to the writer, on an Ohio road, the newly appointed superintendent of motive power learned that the valve oil in use, a mixture of black oil and tallow, costing thirty-two cents per gallon, was giving an average run of 100 miles per quart. He found, also, that an average of one valve seat per day was being faced at the shop. He ordered an oil used that costs fifty cents per gallon, which gives an average of 200 miles run per quart, with only five valve seats to face in four months. Fifteen valve seats to face in a year, as compared with 365, and half as much oil to do the work of the cheaper lubricant. In other words, twenty-five cents against thirty-two.

Another case comes more directly in our line. Oils costing twelve to fifteen cents were found to answer well enough in an engine and dynamo room, so far as heating was concerned, but no pains were taken to look beyond that effect, until, after a time, it was discovered that the journals had a sil-

very white instead of the polished, mirror-like appearance they should present. Calipering the shaft showed that with the cheap oil the shaft had worn away more in three months than it should have done, with a proper lubricant, in as many years.

The time wasted in chaffing and canvassing for a bargain in cheaper oils might be more economically used by the purchasing agent in athletic development, to the end that oil fiends and other greasy tramps might better comprehend the words "no admittance," which should ornament the door of every dynamo room. Present company is, of course, always excepted.

As it is true that no man knows more than the rest of the world, so it is true that no one man can do all that is to be done in the various departments of a central plant. But human nature is weak, and the range of human eyesight is limited. It is not by any means seldom that the principal official of the plant endeavors to transact his business from the table of his roll top desk, without ever getting his legs from under it to see personally how matters are progressing. Jones calls and arranges to have half a dozen lights put in his store. The manager orders the superintendent to have it done. The superintendent passes the order to the foreman of construction—from thence it goes to the foreman of a gang, and he gives the order to a couple of his "Indians," to do the work. From the manager down to the foreman of the gang, inclusive, no one knows anything more about that installation than the King of the Sandwich Islands. If it goes all right, nothing is ever heard of it, but if a fire occurs, or some person is injured, the whole fraternity, the electric light and power service of the entire world, has received a black eye which requires months to heal. What is everybody's business in this case should be the business of an inspector.

Different methods of managing plants are illustrated by a couple of centrals not very far from Kansas City. They represent extremes. In one of these there is a general impression that some one had done it himself. The dynamo is in a building which seems rather to have grown under adverse circumstances than to have been constructed intentionally. It stands on posts, the space between these boarded up from the ground to the sills. It has all the advantages to be derived from ventilation, and it is well up from the ground. In one portion of the room stand the engine and boiler, threatening destruction to the establishment by either shaking it down or blowing it up, if one may judge by the second-hand appearance of everything. The line is in excellent keeping with the rest. My informant says the wire lies on roofs and against buildings, and is a constant menace to person and property. Connectors in place of soldered twist joints are so constant as to give the idea of the company's having secured a great bargain by purchasing all some concern had, and the consequence is that the lights are unsteady, weak and blear-eyed, while the dynamo has assumed a sad, unhappy cast of countenance, such as one sometimes meets the day after Christmas. The reason for all this unhappy condition of affairs is found in a false economy; the employment of incompetent engine and dynamo men and other cheap ignorance. The result may be foreseen—the plant for sale.

But a short distance away from this disgrace to the fraternity and the art, there is a successful plant run as it were by a one man power. There are over 100 arc lights, and one of two persons sees individually every one of these each day. The parties are father and son. The dynamos are as thoroughly cleaned as possible every twenty-four hours, and there are no corners for the accumulation of dirt that are not carefully looked to. There is no greasy saw dust under foot, no oiled rags stowed away for spontaneous kindling material. Everything is kept snug, clean and in order throughout the entire plant, and the total amount of repairs expenses for one year was merely nominal. This plant is not on the market.

These are no fancy sketches. They are taken from life. I fear the first named case has no representative here—it would be well, perhaps, if it had.

A case of false economy I copy from the *Electrical World*, of December 14th, last.

In this instance an electrical engineer, compelled by a railway accident to remain over night in a small town, visited the lighting station to kill time, and found a mere lad in charge, who told him the plant had not turned out as profitable as was expected, and the stockholders were growling about the prospects. Inspection of the circuits showed that while they were in excellent order, with the exception of a loosened connection or two, the lights were not giving out their normal brilliancy. Returning to the station, he located the trouble in the boiler room, where he found the grate bars covered with a mass of hardened clinkers, through which but little air could circulate, and which required the most severe exertion to remove, while further examination showed that neither the flues nor the tubes had been properly cleaned for months. All this was remedied the following day, with the result of plenty of steam, good light, and a saving of about one-third the fuel. The writer goes on to say that even this pointed and striving lesson in economy was lost on the directors. The boy was retained and permitted to go right on running the plant in his own feeble way.

In construction there are many points of present saving at the risk, if not the certainty, of future loss. It costs much less to use the ordinary porcelain door knob for out-of-doors insulation. Yet even with the best insulated cable there is positively no real economy in such construction. Neither should a wooden cleat be made to do service for retaining a cable in position. The former, holding as it does by a single screw, is incapable of sustaining the wire or cable securely, and the repeated replacing and renewing consequent upon the use of these knobs, if the line is kept in proper condition, soon far out-balances the price of glass insulators firmly fixed on iron or wood brackets.

Nor should wires crawling along the face of buildings be fastened to the cornices or water tables. Carried out from the wall by an iron bracket, and attached to glass, two great advantages are gained. There is no contact with the wall, and the window washer cannot stand upon the wires to break the insulation and thus increase the danger of accident, and the possibility

of the conductor being reached by occupants of offices or flats is greatly diminished.

The objection to an iron staple over a heavy wire or cable is that sooner or later the weight of the conductor will sag, weakening the insulation, if not cutting it through completely. The wooden cleat is scarcely better. Experience has shown that upon a line where such cleats are used, the retention of moisture by the wood is almost certain to weaken that point, so that when a ground is developed elsewhere, adding to the strain already existing, the cleat aids materially in the development of the second ground with its consequent unpleasantness.

It costs a little more at the time, but in all such positions the farther we get from the wall or the wood, with air for both ventilation and insulation. the greater the economy in the long run.

No inconsiderable expense is sometimes incurred in covering arc light conductors within a building with a neat and ornamental moulding. It is pretty, but expensive, when, as in an instance where I was a witness after the fact, an unnoticed leak from an imperfect sky-light developed a second ground on a heavy circuit, and the insurance fell short of the damage done. In another instance, where wooden cleats were used to confine a cable in a sidewalk area, grounds were developed in half a dozen places almost simultaneously from a very similar cause, and an expensive piece of conductor was ruined. In the first of these two instances, painting or even bronzing the wire with varnish bronze would have been sufficiently ornamental, and the porcelain knobs could have been treated similarly. In any event, but a few days after a line of wire is run through a room it has ceased to be a nine-days' wonder, and is seldom ever thought of again. So of lines outside. When first placed every one sees them, and all sorts of criticism and comment are the order of the day. In a few days, the gossipers have some other target for their witticisms or remarks, and the wires are permitted to rest.

There is one exception to this rule. In the experience of almost every central plant management, there is one individual who says that under no circumstances can any electric light wire pass his premises. He seems to have been born a coward, and nothing on the surface of the footstool can make him brave, unless it is one free lamp. The economy here is compulsory, and is not to be questioned.

Is not the unfortunate condition of affairs at the East, with all its concomitant newspaper and magazine literature, its bickerings, injunctions and other legal entanglements, traceable either directly or indirectly to a mistaken economy? Is it not fair to presume that at the outset, with a reasonable expenditure in first-class material, much of the business unhappiness and the mental bitterness which the electrical fraternity and the outer world, metaphorically speaking, have been forced to swallow, would have been spared them? A difference of forty, perhaps fifty, dollars per mile of conductor, I believe, would have worked wonders as a peace and harmony panacea, and left fewer raw spots and blisters on the electrical animal to be

gradually nursed back to health and vigor. I may be wrong, but I strongly incline to the belief that where false or dangerous systems of economy have clashed with legal authority, the savings so accumulated are more than balanced by rebates, legal expenses, loss of patrons through stoppages or poor service, or both, in the long run.

Every new industry is compelled to fight for an existance. If, like the electrical enterprise, it must elbow its way into notice, taking the place of a competitor in the front rank, it must make enemies and of necessity antagonize those whom it discomforts and crowds to the background. It is not an attribute of the descendants of Adam to submit tamely to rebuffs and usurpation, and no opportunity is ever lost of disfiguring the countenance of the new-comer. To give occasion for and encourage these opportunities by our own acts seems to me to be short-sighted and illogical.

It is true that electric lighting and power have made wonderful and monstrous strides in popularity, considering the youth of their existence, and they will continue, despite every opposition, to grow in grace and strength, till they have relegated to the rear ranks every other form of illumination, and crowded the present clumsy, hot, ungainly engines from their vantage ground, as the circus elephant clears the tanbark ring for the riders. But the public has some voice in the matter, and the higher the standard of excellency to which the electric light and power man brings his work, the more rapidly will the circle of usefulness widen and the more tranquil will his enemies have become.

The parties in whose interest legislation on the installation and use of electricity for illumination was first invoked, were unwittingly chargeable for the many set backs and the want of progress which checked the enterprise in its early days, and are not wholly free from blame, though indirectly, for the present troubles. These were the fire insurance people. These men deal only with combustion. There is to them a magic in the word incombustible. Say fireproof to an underwriter and his heart leaps with joy. It was a sharp trader who exhibited a cotton covered, painted wire to the insurance people and demonstrated that it did not readily burn. "Just the thing," said the actuary, and the president, and the inspector, and they all smiled at the honor conferred when the cunning merchant baptized it for its godfathers, and called it "The Underwriters' Wire." There is a class of hard citizens who usually have an alias. The underwriters' wire is to-day best known by its nickname.

Another misfortune has been handed down to us from the early days of electrical illumination, which I look upon as one of the original sins of the business. The magneto bell. I have written and scolded and begged to have this abomination sent out of the realm, but like Banquo's ghost, it will not down. I find it everywhere, and if I ask the party in charge of a plant what his insulation is, I am quite often told that it is "first-class, my bell won't ring, no matter how fast I turn it." A short time ago I took occasion to measure the resistance through which I could ring the bell of one of these guaranteed good for 15,000 ohms. With a really smart grinder, we did manage to get a slight response through 6,500 ohms, and when I included the

manager with the first-class line he claimed to have, and turned the magneto crank, the effect was marvelous. He made several florid remarks on the occasion, and bought a bridge set the next day. He has since told me repeatedly, that the investment has paid him several times over in line economy.

A magneto has no method of giving information beyond the fact that there is or is not a bad condition of affairs on the line. If there are two or more faults, there is no possible way of distinguishing when the linemen have found one of these, except in a negative sort of manner. So soon as the insulation is raised to a point where the bell refuses to ring, its maximum of usefulness is reached. Take the case of the line just mentioned. A maximum insulation of less than 6,000 ohms resistance would be the best that instrument would show. The waste of current, the unsatisfactory lights, both as to brilliancy and steadiness, the useless labor of the generator, the coal waste, the danger to life and property, all those faults which follow in the wake of such weak insulation, certainly confer no honor on an economy which persists in using an instrument that can virtually do no more than show up a dead ground.

Nor is it any better as a method of testing the insulation of fields and armatures. It is far more potent for mischief than is generally suspected, for the spark generated is of very high tension, and is quite likely to cut across and open the way for a short circuit when next the machine is used, by weakening the insulation.

And, again, the magneto being the sole dependence of the station, the services of an expert are far more often required than they otherwise would be, while the vexatious delay, the annoyance, and, afterwards, the bill which seems outrageous, cannot be placed to the credit of the economy account. Yet the magneto seems almost as persistent and hereditary as John Calvin believed original sin to be.

The dynamo man and the engineer, when these are two, are often refused, on the score of expense, the most reasonable demands. A case which struck me quite forcibly, I may mention to illustrate my meaning. The attendant at a plant found that a portion of the paper driving pulley was becoming loosened, and that in order to restore it to its normal condition he needed a peculiar form of wrench. The manager was notified, but refused to allow the purchase, although the sum required was but a few cents. He said the company could not afford it, and the engineer must get along the best he could. He did the best he could, and so did the pulley. It went to pieces. The dynamo belt went into the engine governor gearing, and the entire plant had a three days' vacation. The lost time, rebates and repairs bills, would have paid for several bushels of such wrenches as were needed to repair the pulley.

There are other and many simple, but necessary appurtenances of use and convenience too often refused on the score of economy, which repay the original investment many times over during their existence.

Coupling up high potential dynamos in series to save wire is doubtful

economy, to say the least. Insulation is subject to damage from within as well as from without, and two lines of thirty lamps each will last longer and pay better than one with sixty lamps run by two thirty-light dynamos in series.

When renewing the belting of a plant is sometimes a matter of considerable anxiety, occasionally the desire to get a few more days' service out of an old one involves possibilities which may be extremely hazardous. The chances, in case of a break, of the belt becoming playful and familiar, always suggest to me that belts are like oil paintings—made to look at, not to smell of. Yet many a belt has been thrown away as useless because of its having become accidentally greased to that extent that it refused to hug the pulleys. This may be remedied by covering the driving pulley with a leather band, the width of its face, fastened on with counter-sunk bolts. In a comparatively short time the belt, provided it is not again greased, will, by centrifugal force and evaporation, rid itself of the oil, and wear to a good old age.

There is excellent economy in the encouragement of the expert and his assistants, who are, when worthy, the prime support and king-bolt of the business. The hours of such an employé are almost undefined—undefinable. He is, perhaps, taxed beyond his endurance, and many such a man has been lost to his employer through attempted economy in riding a free horse too hard.

It is, however, no trouble to supply the place of one who desires to leave a situation. The woods are full of electrical shoddy, and there are plenty of men who claim the title of electrical engineers and sport a card showing them to be both mechanical and electrical experts. They generally have a place—they call it a position—where a plant is run on an assumed economical basis. Usually these do not last longer than to have made themselves unduly expensive to their employers.

Outside men, too, are often weighed in the balance and found wanting. It is competent for an employé in electrical work to do almost irreparable mischief, and yet not be aware of the fact. There is no gauge by which his claims to knowledge and experience can be measured, except by trying him. The only way I can see to govern this difficulty is to put a thoroughly competent, reliable man over these bell-hanger and shoemaker electricians, to watch and discharge them. The watchful eye of a high-priced man for foreman or superintendent has saved many a dollar to the contractor, which would otherwise have been paid after the plant was supposed to be finished, and before it was accepted.

An extraordinary demand for labor always brings to the front a class of men as unskilled as it is unscrupulous—men who never get up to their maximum of speed until about supper time. Practical electricity is suffering to-day from the wisdom of men who talk learnedly of "galvometers" and "computators" and seem to think that an insulator, like a tumbler, is most likely to be of some service when placed with the open end up.

Yet, the theoretical without the practical ability and education, is no better. It would be poor economy, indeed, to depend solely on what the

expert may have learned in books or at the institute. Two cases contrasted will illustrate my position.

A young man who is at present in a position of considerable importance, in addition to small amount of education theoretically, had combined with this a practical experience in handling circuits and dynamos. A combination of circumstances, such as you all know by experience, called all the experts away from the job—which was a new plant of considerable pretensions—just as it was about ready to run. The engine was started, but soon after the lights were switched in, the dynamo showed an imperfection which rendered it utterly useless. The time for the grand opening was fast approaching, and there was no other dynamo to be had there, while the factory was so far away that to get one was impossible. The trouble lay in the fact that the centrifugal force of the armature had thrown the insulation between the commutator sections out just far enough so that the brushes touched only occasionally. With a very fine file he dressed down the projections, and with another tool, improvised from a second file which he ground down, he burred the edges of the sections to prevent a recurrence of the trouble, started his machine and made the opening run with perfect success, and ate his supper the next morning. That kind of a man is a jewel at any price.

A contrast to this is a case where the hero is a graduate of an eastern college, who has himself been a teacher, but he is only a book electrician. The construction of a central plant has been placed in his hands, he being the electrician of the locality, which is situated in one of the northern States. Reasoning, apparently, that a wire which is covered with a material which the books he studied said was an insulator, that should settle the question, and consequently he said in effect: "No glass or porcelain can be necessary. To purchase these will cost more than staples, so we will use staples." If the fire department and the underwriters keep hands off until that plant is fully under way, there will possibly be some fun right near home.

The day of dark, dingy, unhealthy and damp dynamo rooms, with their dangerous surroundings, is fortunately fast passing away. The false economy which induced the selection of such sites has become self apparent. It has become the rule to prefer clean, light and airy rooms, and an occasional crank on the subject has even gone to the extent of kalsomining and painting the walls, timbers and ceiling. The great advantage, however, in the latter day dynamo room, is the safety which comes of distance from the ground. I look upon the omission, in these days of progress, of any possible safeguard against danger to property or person, as criminal, as contrary to the principles of true economy and extremely impolitic. The public is not near-sighted, nor is it either tongue-tied nor weak in the lungs.

There is an expense attending the change of a circuit or the removal of one, often a no inconsiderable expense, the saving of which may not always be true economy. I refer to the common habit of allowing wires to remain after the change is made, and thus become "tramps"—homeless wires. These vagabonds, whether of No. 6 underwriter or No. 18 annunciator, are capable, like other tramps, of unlimited and incalculable mischief. It is not

directly in the power of the electric light man to control the telephone and telegraph and ticker people, but he can, and should, for his own good, gather up the remnants of discontinued circuits and clear himself as far as possible from chance of blame. The public jumps at conclusions, and right or wrong, there must be a cause given at once for every abnormal condition of affairs, every untoward circumstance, or otherwise the people's greedy appetite for sensation is unsatisfied.

It is questionable if more is not lost than gained by running incandescent lamps above their proper pressure, with the idea of obtaining more light. The increased light thus obtained is indeed great, proportioned to the increased pressure, but the life of the lamp is alarmingly shortened. It is better to run a volt or two below than a volt above normal pressure.

It is false economy to purchase cheap lamps, which consume more current in the production of standard candle power, rather than to buy lamps of higher efficiency at more advanced figures. In addition to the fact that an efficient lamp is an able economic lieutenant to the coal pile, the sizes of wires needed may be less, other things equal, with an efficient lamp. And, of course, as a natural consequence, more lamps may be used to a given number of square millimetres of conductor, and more lamps can be run from the same generator.

Cheap lamps, too, often go upon the same circuits as the better ones, and want of uniformity of voltage throughout the plant is the natural and unfortunate result. This condition, of course, is only found on isolated plants, but it is worth considering as an argument against the peddler of inferior merchandise. Inferior lamps are poorly constructed, the candle power and voltage are not measured by proper instruments and methods, but are guessed at by the eye, and no two consecutive lamps are similar as to candle power under the same pressure.

In connection with this matter of lamps, a method of keeping track of lamp renewals has been shown me, which is claimed to be giving excellent results. The plant where this plan was inaugurated is one of magnificent distances—some three miles separating the extremes of the territory occupied. The company's contract with its patrons is to renew only such lamps as have burned out. All broken globes are paid for by the patrons. The company places at regular stations—usually in drug stores—a few lamps, with a blank, ruled for particulars as to size, price, date, etc., and a receipt to the custodian, for lamps delivered. The depositaries are visited weekly, and settlements made.

The advantages of this plan must be apparent to all. The consumer buys his lamps as he needs, without having either to go far, or keep a considerable number on hand, and the managers are enabled to discover a weak spot in the system if the breakage is excessive at some particular locality. This plan has been in operation something over a year, with the most satisfactory results to all parties concerned.

In conclusion, the prosecution of electrical enterprises is like that of almost any other business, and will be most successful when based on and

conducted with true, proven economy, when the most approved appliances and materials are used, and the best ability in each department is employed. An incompetent fireman is a very expensive luxury, a careless lineman is a drain which saps the profit account of its treasure, while a dynamo man or an engineer who watches the clock more closely than he does the gauges or the brushes, is sure to be a heavy brake on the wheels of progress.

But where all the little army is striving, each individual with his own ability, to aid in the general success of the undertaking, when each feels that he possesses the confidence of his superiors, and that appreciation of his efforts is a stepping-stone to preferment, the current of success flows more evenly, the resistance which generates wasteful heat disappears, and the field of personal magnetism is strengthened and extended, until it permeates the entire organization.

THE PRESIDENT: Before having a general discussion of this topic, we will hear from Mr. Harber, on the subject of line insulation.

Mr. Charles A. Harber, of Kansas City, then addressed the Convention, as follows:

LINE INSULATION FROM THE STANDPOINT OF PRACTICAL EXPERIENCE.

BY CHARLES A. HARBER.

The question of the day for electrical industries is insulation, and believing that any information bearing thereon, and derived from experience, may be valuable, I present a brief record of measurements to determine the relative resistance of several forms of insulation.

In what follows I lay before you the results of daily measurements made in the interests of the company whose central station I have in charge; but I assume to draw no conclusions save the urgent need of constant vigilance. It being my object to draw out rather than exhaust discussion, I leave to others the matters of proper construction, inspection, etc., all of which are equally important.

During the last 24 months I have personally tested the insulation of our circuits. The instrument used is the Electrical Supply Company's standard testing set, composed of a chloride of silver battery of 24 cells, and combination of Wheatstone's bridge with galvanometer and variable resistance, and measures from $\frac{1}{100}$ to 1,111,000 ohms. Measurements are taken shortly before closing circuits, first the precaution being taken, however, to ascertain if the circuits to be tested are crossed by live wires; which, if not producing sufficient current to endanger the instrument, might give an incorrect reading.

These measurements are then averaged daily, and also for the month.

It should be borne in mind that the measurements are limited to the capacity of the instrument used; this, however, is a matter of minor importance,

as the value of insulation in practical work, depends, not on its highest, but on its lowest resistance.

Among our circuits operating Thomson-Houston arc lamps (about 10 amperes at 50 volts) we have four covered, respectively, by P. & B., Simplex, Grimshaw and Okonite.

The external conditions of these circuits are nearly the same. The Okonite circuit, in use 18 months, is $2\frac{1}{2}$ miles long, and operates 50 lamps; the P. & B. circuit, in use 15 months, is $2\frac{1}{3}$ miles long, and operates 40 lamps; the Grimshaw circuit, in use 18 months, is $2\frac{1}{16}$ miles long, and on it are 24 lamps; the Simplex circuit, in use 13 months, is $3\frac{7}{10}$ miles long, and operates 40 lamps.

During the 12 months ended January 1, 1890, measurements of insulation of these circuits have averaged: P. &. B., 485,702 ohms; Grimshaw, 891,392 ohms; Simplex, 895,122 ohms; Okonite, 900,212 ohms.

The average lowest resistance for the 12 months is as follows: P. & B., 35,200 ohms; Grimshaw, 160,400 ohms; Simplex, 163,871; Okonite, 172,913 ohms.

Loss of service during the year, directly attributable to grounds, is, on the P. & B., 301 lamp hours; Grimshaw, Simplex and Okonite, none.

THE PRESIDENT: Before having a general discussion on this topic and the one preceding it, we will hear from Mr. J. E. Lockwood, of Detroit, Michigan, upon how to locate grounds upon arc circuits.

Mr. Lockwood, of Detroit, then read the following paper:

HOW TO MAKE ARC LIGHT CIRCUITS SAFE.

BY J. E. LOCKWOOD.

I come before you to-day to speak upon a subject which I am satisfied is of such importance as warrants a very careful investigation, and I am satisfied that if we make it in a thorough manner and then apply to the best of our ability, the knowledge thus gained, we will have done more toward ending the cry of the press and people about the dangers of electric lighting, than could possibly be done in any other manner.

The subject of my paper is, "How to Make Arc Light Circuits Safe." Now, I do not mean to convey the idea that arc light circuits are not, and will not always be dangerous, under certain circumstances; but I mean that with our present knowledge and with the appliances that can now be obtained to enable us to apply the same, we can make our arc circuits so safe to our employés and the general public, that accidents will be of such rare occurrence as to attract no adverse criticism from either the press or the people.

We all know that the past year has been productive of more harm to electrical interests than any other year since we started, and there is no gainsaying the fact that it is *all* the result of accidents from arc light circuits, such as are usually termed "high tension circuits"; for, although there have

been a few accidents due to other causes, they of themselves would have caused no comment. Let us then benefit by the lesson we have had, and from this time forth see that nothing is left undone to prevent a recurrence.

Now, the first thing to do is to locate the causes of dangers and troubles, and then next to show a way to avoid them. As to the causes, we all know that the prime cause in almost every instance is a grounded circuit, and though there are other things to guard against, I think that if we can effectually guard against grounds, or to almost the same end, be sure that the instant a ground appears that fact will be known and the ground located so that it can be quickly removed, the other causes will not be likely to result in much trouble. They can be more properly and effectually taken care of by issuing good and complete instructions to our employés, and then seeing that they are enforced, than by means of appliances at our stations. Now, to avoid the dangers resulting from grounds, we must first provide some means or system to enable us to know where a "ground" comes onto a circuit. It has been suggested that a permanent ground be made on each circuit through a high resistance with an annunciator drop in circuit, so that when a second ground occurs a portion of the current will be shunted through the high resistance and drop and thus cause the drop to fall and indicate the coming on of the ground. An apt suggestion in regard to trying this device has been made, viz.: That before asking others to try it, the inventor should first connect it to a high tension arc circuit and then make the second ground through his body. If this suggestion is carried out, I do not think this particular inventor will bother us any more.

Many other ideas have been advanced and schemes tried to accomplish the desired result, but to-day I know of but one device that will automatically indicate a ground the instant it appears on a circuit, and that of itself creates no danger. This is the Rudd ground alarm, the invention of Professor Rudd of the Western Electric Company, of Chicago, and it is in use at the station of the Chicago Arc Light and Power Company, and I believe at a few other places, The Rudd system is as follows, the description and cut being taken from the *Western Electrician* of August 24, 1889.

Continuing, Mr. Lockwood said, reading from the *Western Electrician:*

"Referring to the diagram, *D* represents the dynamo; *C* the circuit of lamps; *E* and *E'* condensers; *S* a telephone drop; *B* a vibrating bell. It will be observed that the bell is worked by one cell of battery, and the bell circuit is closed when the shutter of the telephone drop falls. The details of the drop are not shown, but they are the same as those which are found in ordinary telephone work. The shutter is held by a catch which is lifted when the magnet is actuated. When the catch is lifted the shutter falls by its own weight, and thus closes the bell circuit. The drop is operated by current from the dynamo in the following manner: One pole of condenser *E* is attached to one pole of the dynamo, and one pole of the condenser *E'* is attached to the opposite pole of the dynamo. Thus a free pole is left in

each condenser. These free poles are joined together and take a common path to the ground through the drop *S*. In using the apparatus, the shutter may fall at the same time of connecting up, on account of the static capacity of the circuit, but this fall may be ignored and the shutter may be set back again. The legitimate fall of the shutter will take place upon a sudden disturbance of the insulation of the circuit, if the disturbance is marked and confined to a small portion of the circuit, as is the case when a ground comes on. While the insulation of the circuit remains as it was when the apparatus was set, the condensers do not permit any appreciable passage of current. By the use of this device, instant notice will be received of the coming on of a ground and valuable time may be saved in the matter of removing it." (End of article.)

It will be seen from the diagram and description that this device does not ground the circuit, but acts from the static effect due to a disturbance in the insulation of the circuit. In applying this device, switches are introduced at *A* and *A'*, so that in the event of two or more circuits being connected together, only two condensers are left connected, and those are the two that represent the two terminals of circuits to which the dynamo is directly connected.

If this system is used, a ground will be indicated the instant it appears, and we then have before us the problem of locating it. If, however, the above system is not adopted, the next best thing to do is to test every circuit regularly each day at certain specified hours, and I should advise a test every two or three hours while the circuit is in operation and two tests while not, the last two to be made, one the first thing in the morning, the other just a sufficient time before starting up to give time to remove the ground if one is found to exist. If any circuits are operated all the time or nearly so, all four tests should be made while in operation at regular intervals.

As a result of my experience and observations, I believe that the majority of grounds occur while circuits are in operation and that the best time to test for same is at this time. In most cities there are many circuits that never have all their loops thrown on except when the circuits are in operation, and, therefore, this is the only time when the circuits can be tested in their entirety. To make these tests would require appliances to test both live and dead circuits, or, in other words, circuits in operation and circuits not in operation. For the first or live circuits I would advise the use of any of the appliances which I will describe further on, that can be used to locate the grounds. For the second, or "dead" circuit, I would advise any of the testing sets now made by electrical instrument manufacturers, which are a combination of rheostat and galvanometer on the Wheatstone bridge principle, and which will test satisfactorily up to at least one megohm. A brass plate at the switchboard should then be provided and the same connected well with the earth. Now, by connecting one wire from your testing set to this ground plate and the other to a terminal of a circuit, your electric light circuit and the earth become portions of the testing circuit and the ground resistance between these two can then be measured. The total resistance, less the resistance of the portion of the circuit between the set and the ground, will be the

resistance of the ground connection. No ground connection of less resistance than 100,000 ohms should ever be allowed to exist permanently, and preferably not less than one megohm.

We now come to the locating of grounds when they are found to exist, and we will first take up grounds on dead circuits. To carry out this work we need the combined galvanometer and rheostat already spoken of, and the principle upon which the same should be applied is to divide your circuit into two parts by means of a cut-out box provided for this purpose or other convenient means, and then to find upon which of these two parts the ground exists. After having determined this, we can then connect the two parts of the circuit together and test next from a point about midway in the part upon which the ground exists, first separating the portion of the circuit leading to where the first test was made from that portion leading beyond this point; if the ground is still beyond this point, we must close the circuit here and again open it farther on and thus, finally, locate the ground. But if the ground is located on the portion of the circuit leading to where the first test was made, we then know the ground to be between that point and the point where we are now testing. We can thus, by dividing and subdividing the circuit, locate the exact portion upon which the ground exists. As an adjunct to the foregoing, and as a convenient means of cutting the current off from a portion of a circuit without affecting the whole, as is sometimes necessary on account of a fire, it is advisable to divide each circuit up into four or more sections and to provide cut-out boxes so that any one or more of these sections can be cut entirely out of circuit.

In testing for grounds, each section could then be tested separately, and thus locate that upon which the ground exists, so that if necessary all of the circuit but the grounded section could be started up, and then as soon as the ground is removed this section could be cut in.

In addition to providing these cut-out boxes, loop circuits only should be put up, their advantages being too well known to need any explanation.

We now come to the locating of grounds upon live circuits. I will first describe the system used by Mr. Law, in Philadelphia, it being the same as I have used in testing high voltages for the last three years, and if I make any errors, I trust Mr. Law will correct them. The principle of this system is that high voltages can be easily tested with ordinary appliances, such as incandescent lamps and ordinary voltmeters, if we test by steps, to do which as many incandescent lamps of as nearly as possible a uniform resistance should be connected in series as there are arc lamps on the largest circuits to be tested. If, then, this series of incandescent lamps be connected across the terminals of the dynamo or circuit where the greatest difference of potential exists, as the incandescent lamps are connected in series and as there are as many as there are arc lamps on the circuit, each incandescent lamp will get the same number of volts as each arc lamp. Mr. Law states that he prefers using incandescent lamps of as nearly as possible the same voltage as his arc lamps, say of from 45 to 50 volts, so that when they burn at their normal candle power he will know that they are each getting the same num-

ber of volts as his arc lamps average. Now, before going farther, I wish to explain that as the current leaves the positive terminal of the dynamo it is at its maximum voltage, which we will call 3,000 volts, and that as it passes through each arc lamp and is lowered at an average of about 50 volts per lamp, we have only to find the voltage of the current at the point of the circuit where the ground exists, and then to divide the difference between the maximum voltage and the voltage at this point by the average voltage per arc lamp, to find how many lamps are between the ground and the positive end of the circuit. If, then, we have a list of the lights on this circuit arranged in the order in which they are connected, and stating which is the positive and which the negative end of the circuit, we have only to count off the lights and thus locate the ground.

This is substantially what is done by Mr. Law, with the simple difference that as he has means for cutting down the number of incandescent lamps in the series, he, therefore, connects one end of the series to a ground plate and the other to one end of a circuit and if there is any indication of a ground, he then cuts down the number of incandescent lamps in the series until those left in the circuit burn at their normal candle power. The number of these burning then corresponds to the number of arc lights between the end of the circuit from which the test is being made and the ground. To prove, he tests from the other end of this circuit, and then adds to the result of his first test the result of his second one, and their sum should equal the total number of arc lights on the circuit. If, however, the number comes short he adds half the shortage to the result of each test, and thus approximately locates the ground. The ground having been located, it simply remains to send a competent man to examine the circuit at this point and to discover and remove the cause.

My objection to this system of testing is based upon two reasons, first, because low voltage incandescent lamps are used that take about one and one-fourth amperes to bring up to normal candle power, and thus create a danger by the liability of this amount of current when passing through a light ground to cause fire, and the possibility of accident to persons who may come in contact with the circuit being tested, at a point far enough removed from the end at which the test is being made to cause serious results. What we want is to remove all the danger we can, not add new ones.

My second objection is based upon the very point at which Mr. Law finds his system does not work satisfactorily, viz., that his system is not suitable to locate a weak or high resistance ground. When we want to make any certain resistance that may be in series with other resistances as small a factor as possible of the whole, we use high resistances for the others, not low ones, such as low voltage lamps. Even 60 lamps of a voltage of about 50 would only have a hot resistance each of about 40 ohms or less, which would only make a total resistance of about 2,400 ohms, and as to make the test it is necessary to have these lamps or a portion of them up to candle power, we can see that the highest possible ground resistance that could be tested would be by Ohm's law, the electromotive force divided by the current

required in amperes, which, in this case, would be 3,000 divided by $1\frac{1}{4}$, which would give us 2,400 ohms, the highest resistance ground that we could test.

Now, we should at least be able to test up to 100,000 ohms, and as with a voltage of 3,000 we could only get a current through this high resistance equal to 3,000, divided by 100,000, we could thus only get $\frac{8}{100}$ of one ampere, and we should, consequently, use a system that could be operated by this amount of current. Now, to make our ground the least factor in the test, and as we would have only about one-half our incandescent lamps or high resistance coils in circuit in most tests, we must use resistance coils, and make them of such a resistance that 30 will equal at least one megohm, and thus each one would be about 33,000 ohms. As this high resistance is necessary to apply this system satisfactorily, you can all see plainly why I do not approve of the incandescent lamp system. If, however, incandescent lamps are used for ground testing, only those of the highest possible resistance and that use the smallest fraction of an ampere are suitable, and of all the styles now on the market, the eight candle-power 110 volt lamp is the most suitable, because, if as many of these lamps are used as there are arc lamps in circuit, they will each only get about 50 volts, and consequently about one-tenth of of one ampere, and will thus enable us to test up to a certain resistance equal to the maximum voltage of our circuit, say 3,000 volts, divided by the amperage, one-tenth of an ampere, which would be 30,000 ohms, a great increase in range from the low resistance lamps, which only enabled us to test up to 2,400 ohms. If lamps are used we should also use a high resistance dead-beat voltmeter, such as is made by the Weston Electrical Instrument Company, and this should be connected in shunt around the first lamp of the series, which should be of enough higher resistance than the rest of the series to make its resistance, when connected in multiple with the voltmeter, just equal to that of each of the other lamps of the series. We could then, when making our test, consecutively cut out of circuit the incandescent lamps until the voltmeter indicated as nearly as possible the voltage which our arc lamps average. The number of incandescent lamps still remaining in circuit would then correspond to the number of arc lamps between the end of the circuit being tested and the ground. I would much prefer thus using a voltmeter and high resistance lamps to using low resistance lamps, and bringing them up to the normal candle-power. This outfit could also be used to find the average voltage of arc lamps on any circuit, and having determined this point and also how many lamps the line resistance is equal to, we could then test and find out at any moment, how many lamps are being used on this circuit, or, if we are running a number of circuits from one dynamo, we could find how many lamps are burning on each circuit, and plan our changes and combinations understandingly. A great improvement on this system would be a voltmeter to read up to five or six thousand volts, such as Mr. Law says can be made by the Weston Electrical Instrument Company, and the amount of the improvement would depend entirely upon the fraction of an ampere used to operate this instrument. The smaller the

fraction, the greater the improvement. With such an instrument, the coming on so suddenly of a ground when a test is being made, even if the opposite extreme of the circuit, would do no harm to the instrument. This instrument should be as nearly as possible dead-beat, so that in testing for a swinging ground the instrument would indicate accurately the voltage at the ground, even if the connection only existed for a moment. We now come to a system of testing which I think a great improvement over those already mentioned, except in one particular, viz., the testing for swinging grounds. For this purpose the extremely high resistance and high capacity dead-beat voltmeter I consider better than anything else. This new system I had the fond belief, up to a few days ago, to be original with myself, but I find the old saying, that "there is nothing new under the sun," has again been exemplified by my finding that practically the same system is in use at the stations of the Arc Light and Power Company, in Chicago, it having been put in, I understand, by Professor Rudd, of the Western Electric Company, of that city. The system, in brief, is similar to the Wheatstone bridge, as the principle is to form a shunt circuit between the terminals of the arc circuit by means of from 60 to 100 coils of high resistance connected in series, and then by means of any very high resistance galvanometer finding the point on the shunt circuit from which no current will flow to ground, then by noting at what point on the shunt or testing circuit this neutral point is, the ground can easily be located. In applying this system, I would provide means for cutting out of circuit any desired number of these coils, with the idea of using at each test only as many coils as there are arc lamps burning on the circuit at the time of the test. Then when the neutral point is found you can see at once, without figuring, between what lamps on your circuit the ground exists. The advantages of this system are: First, it creates no new dangers; second, the question of how high a resistance ground can be tested depends simply upon the sensitiveness of the galvanometer; third, it is quick and accurate and cannot be damaged by grounds suddenly coming on when testing. Now, as a necessary adjunct to any of these systems of testing, there should be prepared a list of the lights and service on each circuit arranged in the order in which they are connected in the circuit, and stating which is the positive and which the negative end of the circuit. With such lists a competent lineman, when notified that there is a ground so many lamps distant from the negative or positive end, as it may be, of a certain circuit, should have no difficulty in quickly locating same; to enable him to safely and quickly do this, he should be provided with a high reading voltmeter, so that by going directly to the point where he thinks the ground exists and testing from the circuit to the ground with his voltmeter, he could tell whether the ground was very near or not, and if not, about how many lamps were between this point and the ground. Then by testing again a little farther on he would immediately see whether he was approaching or leaving the ground, and thus could quickly locate same. In conclusion, I would say that I firmly believe that if we use such a system of testing as last mentioned, and equip our circuits with good light-

ning arresters and some such device as the circuit openers lately brought out to disconnect the dynamo from the circuit when the current ceases for an instant, through the breakage of a wire or any other cause, and then see that our employés use these appliances and do their utmost to keep all lines clear of grounds, we will have few accidents, and the press will have little or nothing more to say about the dangers of electricity.

The paper was received with applause, and discussion of the subject was in order.

MR. M. D. LAW (of Philadelphia): I have listened with great interest to the reading of the paper presented by Mr. Lockwood, and I have been specially interested in that part of it relating to central station work. The explanation that I gave of testing for grounds is one of the first that has ever been presented to the Association. It is a very good method, but still, probably not as good as the one that you have just listened to. It is a method that lies within the reach of all. My reason for using a low voltage of lamp was simply because it was easier to locate the ground, and in the undemonstrated way in which we were doing it, it was easier for the men that were in charge of the station at that time to grasp the idea.

At the present time, I have been experimenting in my station, and have an apparatus perfected, not knowing that others had been reaching out in that same line to test ground by the Wheatstone method. I am very glad to see that others have made advances in that direction. I use at the present time a simple method of diagrams, which might be interesting to some of you. Perhaps others have used the same. I print a sheet of paper which is, I think, about 20 inches square, and is ruled in red lines one-half an inch apart. Those lines are marked up by the streets, both north and south, in the section or territory through which a certain circuit will pass. In constructing that wire, we started out on these red lines and followed them by corners and routes, the entire length of the circuit, marking at the terminal or station end the positive or negative side of that circuit. At the present time I am keeping the locations of lamps on that circuit simply by a lead pencil, that they may be easily erased and changed. I have a blank, called a line report, which I require my foreman of lines to hand in, with the complete report of the condition of changes in lines from day to day. As that comes into my desk it is very easy to rectify any changes

that have been made upon that circuit. That may, perhaps, be an idea to some of you, to have a diagram of circuits from your stations.

Mr. De Camp: It is now nearly one o'clock. I do not think we can finish up this morning, and, therefore, I move we now adjourn to meet at 2.30.

The President: I think, Mr. De Camp, if you will pardon me one moment, that we might close up the discussion on these topics. This matter is now before the Convention. We may also be able, possibly, to get the report of two or three committees before adjournment. Is there any further discussion on the subject?

Mr. Brophy: Mr. President, I believe any system of testing grounds on an arc light circuit by a low volt resistance in the circuit of the ground is dangerous. The plumber and the gas fitter, those worthy individuals who are a terror to all electric light men, get in their work unbeknowns, and an imperfect ground is established, possibly, between a gas pipe and an arc light circuit. It is desirable in testing to reduce the amount of current traveling over that part to the lowest possible amount. In addition to having a proper method of testing and clearing the lines of the ground, another very good thing to do is to clear your lines of everything in the shape of obstructions. There may be a wire run by a boy who has set up a bell somewhere, and whose fond parents believe he knows everything about electricity. Not to enter into any arrangement by which any grounded circuit can be run on your own poles and fixtures.

Mr. Gregory (of Chicago): Mr. President and gentlemen: We are running about 300 arc lights in Chicago. We have our chief linemen go over that circuit and see every foot of it at least once or twice a month. We use the galvanometer to take our measurements by. We think by going over it frequently, the linemen can oftentimes see defects and observe repairs which can be made in the line, where they would not be affected until a storm occurs. In that way, out of seven circuits, for a period of over seven months, we have had no occasion to shut down for any line trouble. We haven't any newly devised schemes for locating grounds. Our circuits are all underground running through alleys. We measure from one side of the street to the intersec-

tion of another, occasionally pull those wires up, fix them and put them back again. In that way we save a great deal of trouble. We have no air circuits at all, except where we come out of the alleyways. We come out and run into a building, if it is only one or two numbers on the street, we go right back into the alleyways. We think we have saved a good deal of money in that system. Any indication of trouble is readily indicated, and we at once send a man who removes it.

MR. LOCKWOOD: Mr. President, I omitted one point in my paper. After we have put up our lines in the best manner we know how with our present knowledge, and equip with the best appliances we can get, using those appliances in the best way, we should keep a record of our knowledge of the grounds and their causes; and after a short time in studying those causes, I think it will be found where we can improve upon our method of construction.

MR. LAW: In reply to Mr. Lockwood, I will say that I have prepared for my ground testing a sheet on which a report is kept of every test made during the day, every two hour test; and if a ground is discovered, if found upon the circuit, the time at which that ground is removed, and the character of that ground, is specified in the remarks upon this sheet.

MR. BROPHY: I would like to speak upon one topic touched upon yesterday, and that is the desirability of some method of breaking the line, without cutting with an axe, or anything of that kind; some method of disconnecting the lines in front of a building which is on fire, for the benefit of the fire department. There is no man who has studied up the sensational reports printed in regard to electric light matters so thoroughly as the average fireman. There is no man who dreads an electric wire more than he. After a wire is cut and let into the street, though it be as dead as a door nail, they do not know it. If we had some method of disconnecting the lines from the dynamo by a system of switches, so they shall know the wire is perfectly harmless, it will be of great value to everybody interested.

MR. LAW: I can say that is practiced at the present time with us, and that every central station should send a competent man to every fire with the fire department. That has been done in Philadelphia now for nearly nine years. In some cases it has

become necessary to shut down a complete circuit, where there was any danger of walls falling and breaking down the wires, which did not return upon that same street, if a wire should return upon that same street, and there were no cut-out cuts provided for turning off the section beyond. I have provided in our fire wagon a cut-out which will hook over the wire, with steel-pointed screws with a large wooden knob at the top, that a man can handle with perfect safety on any wire. Using that, you do not have to cut away the insulation; but the point of the screw will penetrate through and make contact with the wire. Then, by the use of properly insulated cutters, a man can cut loose any wire that is liable to give trouble. We have done it in quite a number of cases in Philadelphia. We cut the wires, so there is no possible danger to the firemen. The firemen understand this thoroughly. They know if they come to a fire in which a wire is passing in front of a building, or into a building, as a rule, the foreman of the hook and ladder company will ask me if everything is all safe. A man is generally on duty who stays by the hook and ladder companies, so they know where to pick him up at any time. The firemen have orders from the chief of the department to allow any of the electric light people to ride upon the apparatus if it becomes necessary to get to the fire quickly.

THE PRESIDENT: If there is no further discussion of this topic, with the usual instructions to the Secretary, it will be passed. I had designed at this time to introduce to you your new President. But as the number in attendance is so small, I think it would be better to defer it until after the delivery of Mr. Edison's phonogram, this afternoon.

COL. RANSOM: Mr. President, your new President expects to leave on the four o'clock train, as I understand, so if you desire to present him, it had probably better be done before the exhibition of the phonograph.

THE PRESIDENT: That is a suggestion which will be followed. The report of standing committees is now in order. I will call for the report of the Committee on State and Municipal Legislation.

MR. DE CAMP: I am not chairman of that committee, but I have the report here which has been passed upon by the com-

mittee which I have the honor, sir, of representing. I will hand the report to the Secretary, and ask him to read it.

Secretary Garratt then read the report of the Committee on State and Municipal Legislation, which was as follows:

REPORT OF THE NATIONAL COMMITTEE ON STATE AND MUNICIPAL LEGISLATION.

1. For the sake of convenience and brevity, this committee recommends that its name be changed from "The National Committee on State and Municipal Legislation," to "National Committee on Legislation."

MEMBERSHIP.

2. The present membership of the committee is as follows:

Alabama, ...	
Arkansas, ...	
California, ...	George H. Roe.
Colorado, ...	C. H. Smith.
Connecticut, ...	John C. English.
Delaware, ...	
District of Columbia, ...	Allen R. Foote (Chairman).
Florida, ...	
Georgia, ...	H. W. Palmer.
Illinois, ...	C. H. Wilmerding.
Indiana, ...	John Caven.
Iowa, ...	
Kansas, ...	L. A. Beebe.
Kentucky, ...	
Louisiana, ...	
Maine, ...	William R. Wood.
Maryland, ...	J. F. Morrison.
Massachusetts, ...	F. A. Gilbert.
Michigan, ...	J. E. Lockwood.
Minnesota, ...	
Mississippi, ...	
Missouri, ...	Joseph Corby.
Montana, ...	
Nebraska, ...	
Nevada, ...	
New Hampshire, ...	Alonzo Elliott.
New Jersey, ...	Henry W. Pope.
New York, ...	E. A. Maher.
North Carolina, ...	D. A. Tompkins.
North Dakota, ...	Vincent S. Stone.
Ohio, ...	Charles R. Faben, Jr.
Oregon, ...	P. F. Morey.

Pennsylvania, ...	A. J. De Camp.
Rhode Island, ...	Marsden J. Perry.
South Carolina, ...	George B. Edwards.
South Dakota, ...	
Tennessee, ...	
Texas, ...	
Vermont, ...	M. J. Francisco.
Virginia, ...	
West Virginia, ...	John B. Gardner.
Wisconsin, ...	S. S. Badger.
Washington, ...	

A persistent effort is being made to complete the membership, so that every State shall be represented. It is hoped that a leading central station man in each of the States not represented will soon be found who will qualify as a member of the Association, if not already a member, and accept an appointment as the representative of his State on this committee. The assistance of every member of the Association, and of all others interested in its welfare, is solicited to secure this consummation.

ELECTRIC EXECUTION.

3. The resolution adopted at the Tenth Semi-Annual Convention, directing this committee to use its efforts to secure the repeal of the electric execution law in the State of New York, has not been acted upon. The committee thought it best to make no move in that direction while the question of the constitutionality of the law was undetermined. While re-affirming our belief that the law should be repealed, we are of the opinion that if it is to be enforced, it should be done in the most effective and humane manner. That the law may be so enforced, we believe it necessary that it be so amended as to require a special apparatus to be devised for the purpose, that shall generate a current of not less than 10,000 volts. In this behalf, this committee recommends the Association to instruct it to co-operate with the New York State Association in securing such amendment of the law.

STATE ASSOCIATION.

4. Since the Tenth Semi-Annual Convention, this committee has engaged in the work of promoting the organization of State Associations. The reason for this action is based on the fact that all legislation affecting the interests of central station companies is either State or Municipal. A State Association is necessary in order to provide a medium through which the central station companies doing business in a State can act to accomplish a purpose in which they have a common interest. As there is no uniformity in legislation as between States, State Associations are necessary to enable the National Association to carry out the "plan of work" adopted for this committee in the most effective manner. Through the grouping of central station companies into State Associations, and of State Associations into the National Association, the full strength of the prestige and influence of the entire industry of

the country can be brought to the support of any State Association, or of any central station company needing assistance.

5. In pursuance of this policy, State Associations have been organized in the following States:

Massachusetts.
Maryland, including the District of Columbia.
Connecticut.
Rhode Island.
New Hampshire.
Maine.
Michigan.
Illinois.
New York.
New Jersey.

This work will be continued until all the States are organized.

6. Membership in these associations is confined to central station companies doing business within the State. Any such company may become a member, and be represented in the meetings of the State Association by any one or all of its officers or employés, one of their number being designated to cast the vote of the company at the meeting.

7. While subjects of legislation have been the exciting cause for these organizations, it is expected that in the course of time the development of the work that may be accomplished through them, will render the legislative feature of the least importance or benefit. The improvements in mechanical electrical business methods that can be initiated or perfected through the bringing together of those having a common interest in such subjects, cannot well be over-estimated.

8. In view of the number of State Associations now organized, and the prospect of the organization of a number of additional States in the near future, this committee recommends the Association to instruct it to report for the action of its next Convention, such changes in the Constitution as will in its opinion best provide for the membership and representation of State Associations in the National Association.

DANGERS TO INVESTMENTS IN CENTRAL STATION COMPANIES.

9. Closely allied with the subject of legislation is the subject of business methods, by which manufacturing companies seek to make sales of their apparatus. As this committee was created for the purpose of instituting measures for the protection of the capital invested in electric central stations, it considers the subject of the competition of manufacturing companies with central station companies for public lighting contracts, to be a most proper subject for the consideration of the Association.

10. Within the last six months every dollar invested in electric central stations has felt a depreciating influence of an exciting and misinformed public opinion. From such a cause, these investments must continue to suffer until the means is found of furnishing the public with information that it can

accept as being reliable, impartial and authoritative. While the damage done in this direction is great, it is not vital. The evil can be corrected.

11. Of a different character is the damage done to central station investments by those manufacturers who have, either openly or under cover of other names, sought to create a market for their apparatus by underbidding an established local company in its proposal for a public light contract. A low bid for public lighting is invariably used as a means of obtaining a franchise and the right to do business in a city or town, in opposition to an existing company. Manufacturers have acquired their power to do this through the wealth and prestige they have gained by supplying existing companies with their apparatus. No demand can be more just than this:

"The value of investments in electrical apparatus and construction that have been made on the basis of manufacturers' representations of earning capacity, must not be depreciated by the cutting of prices by or through the assistance of manufacturers."

12. This evil is vital. In destroying the profits of the business, the reason for its existence is destroyed. It is folly to discuss the mechanical or electrical efficiency of a plant, if its financial efficiency is to be destroyed by cutting the price to be received from the service it is to render, to a point which destroys all possibility of securing a fair profit for the use and risk of the capital invested in it.

13. For the correction of this evil, the Association must rely upon the work to be done by the co-operation of all central station companies to secure reasonable legislation and just conciliation.

THE PRESIDENT: You have just listened to a very important report from the Committee on State and Municipal Legislation. This committee has been actively engaged during the past six months in the work indicated in the chairman's report. Very much has been accomplished that will greatly strengthen the national electric light interest and the work of this Association. There is in this report, however, one point to which I desire to call your attention. I believe it recommends that the matter of underground conduits and conductors be referred to this committee.

MR. JOHNSON: I think you are mistaken.

MR. PERRY: There is no reference whatever to underground conduits made in this report.

THE PRESIDENT: I was given to understand that there was. There was in the report as originally presented to me, and I supposed it was embodied in this report. What is your pleasure with reference to this report?

MR. DE CAMP: I move the report be received.

Dr. Mason: Mr. President, let me inquire if the reception of this report is not tantamount to the adoption of all its recommendations?

The President: Certainly not. It is simply the reception of the report.

Mr. De Camp: Then I amend my motion and move that the report be received and approved.

Dr. Mason: It seems to me this report covers not only a very wide range of subjects, but also deals with matters of considerable importance. I am not prepared to say that I object to anything in the report; but I must say that I am not prepared to vote for the adoption of all its recommendations without consideration. I, for one, will say that I do not understand all the questions that are brought up in it. Might it not be referred to a competent committee rather than we should off-hand adopt all these suggestions. There are some things that strike me as revolutionary, though they may be the most desirable things in the world.

Mr. Armstrong: The gentleman's suggestion would have the effect of referring the report of this committee to another committee. I should not feel very comfortable, under those circumstances, if I were on the committee that made the report, if that action was taken. I think the suggestions of this committee are admirable, and it seems to me they have exhaustedly considered many important subjects. Whether all these recommendations ought to be complied with, I am not prepared to say. I would like to receive the report, and if there are any serious objections to carrying out the recommendations, the matter can be referred to the Executive Committee.

Dr. Mason: I think I can state my views a little clearer. I have not the slightest suspicion that any part of the report is objectionable, but I think it is dangerous for us to adopt as a whole a report embracing so many important features. I move we consider the recommendation *seriatim*.

Mr. Perry: I trust you will bear with me for a moment. I object to the reference of the report to any committee. That report is from a committee into whose hands you put certain matters, and they have reported to you. I insist that this body act upon the report as submitted, in some form; that is for you

to do in your own wisdom. There are no recommendations in that report that you are asked to adopt that are revolutionary. I have not the slightest objection to taking up each section and examining it. There are recommendations suggested that have been gone over very fully. There is a broad field of State and municipal legislation, which is closely allied with certain other evils. We have barely called the attention of the Convention to that fact to put them on their guard, nothing more.

DR. MASON: I then move that the recommendation be considered *seriatim*. In view of the remarks made by Mr. Perry, I regard that as essential. There are suggestions there which it would take more than a New Jersey or Philadelphia lawyer to comprehend on the instant.

THE PRESIDENT: The Secretary will read the first section.

Secretary Garratt read section one of the report, as follows: "For the sake of convenience and brevity, this committee recommends that its name be changed from the National Committee on State and Municipal Legislation to National Committee on Legislation."

DR. MASON: I move the adoption of that section of the report just read. (Seconded. Carried.)

SECRETARY GARRATT: The second clause of the report is simply the membership of the committee as read in the first instance.

THE PRESIDENT: The membership of the committee will be as recommended in the report, unless there is some objection.

SECRETARY GARRATT: The third recommendation of the committee is in reference to electric executions, and is as follows: "The resolution adopted at the Tenth Semi-Annual Convention, directing this committee to use its efforts to secure the repeal of the electric execution law in the State of New York, has not been acted upon. The committee thought it best to make no move in that direction while the question of the constitutionality of the law was undetermined. While reaffirming our belief that the law should be repealed, we are of the opinion that if it is to be enforced, it should be done in the most effective and humane manner. That the law may be so enforced, we believe it necessary that it be so amended as to require a special apparatus to be devised for the purpose, that shall generate a current of

not less than 10,000 volts. In this behalf, this committee recommends the Association to instruct it to co-operate with the New York State Association in securing such an amendment of the law."

CAPTAIN BROPHY: The methods used to throw discredit on the electrical execution business by parties interested in securing the adoption of certain devices for that purpose are well known and I need not recite them; but I think we had better go slowly and not leave the Association open to attack. As this resolution reads, it means nothing. "A current of 10,000 volts" is meaningless, and could be used greatly to our disadvantage by interested parties.

SECRETARY GARRATT: I was about to speak on that point. Electricity may kill people in two ways, by nervous shock or by cooking the person—burning them. If this is to be adopted, I would suggest two things: First, that in speaking of a current of 10,000 volts, these words be added, "If the machine be devised to deliver an alternating current, it shall produce a like heating effect in a thin wire or carbon filament as a direct current machine operating at a pressure of 10,000 volts." I would also add, that this machine deliver through 2,000 ohms of external resistance, not over two amperes, nor less than one! That will kill the man in accordance with our ideas of humanity. A 10,000 volt machine might be devised which would be equal to the tortures of the Inquisition.

MR. LOCKWOOD: I move that the recommendation read, "That special constant potential apparatus be devised to furnish a current of not less than 10,000 volts potential and capable of delivering not less than 20 amperes."

MR. FABEN: The committee did not feel that it was part of their province to specify a bill for passage by the New York Legislature. The suggestion was simply made that the voltage be placed high enough to represent a blow and not a burn.

SECRETARY GARRATT: I will withdraw so much of my amendment as relates to the amount of current to be delivered.

MR. PERRY: It seems to me that it would be better to let the State take care of that matter themselves. The fact is that the law has been adopted by the State and stands, and for political and other considerations, it will stand and it is impossible

to procure enough votes to repeal it, and if you did so you would be obliged to pass it over again. We want, if they are going to use electricity, to make a machine strong enough to kill and have it free from the odium attached to an ordinary machine. That is what was in my mind. I do not think we ought to say anything about alternating or direct currents, it does not seem to me wise to speak of that.

SECRETARY GARRATT: I withdraw my whole recommendation.

THE PRESIDENT: The question is now upon the original resolution.

MR. LOCKWOOD: I move to amend by adding the words, "And capable of delivering a quantity of current unquestionably sufficient to kill."

CAPTAIN BROPHY: With one ampere of current and 10,000 volts it is a good deal like killing a mosquito with a ten-ton hammer to attempt to execute a criminal. If you take any notice of this at all, it seems to me you are putting yourselves in the position of killing a fly with a club by recommending the adoption of special devices for killing criminals.

DR. A. F. MASON: I like what Captain Brophy has said, but I hope that if they will use electricity for this purpose, they will do it by machine specially devised for that purpose of killing and not for light.

MR. DE CAMP: Cannot Captain Brophy's suggestion be carried out by striking out the words: "That shall generate a current of not less than 10,000 volts"?

MR. PERRY: This committee had in mind the very thought which Dr. Mason has expressed. I am here as the exponent and champion of no system. The fact that the State of New York had adopted certain machines to do this work would be a serious disadvantage to that particular make of machine. Any sensible business man who has watched the matter knows the condition of the public mind on the subject, and we thought, if possible, to remove the lighting business far away from the killing business, and make the line a demarkation so broad and so sharp that it would not be possible for the reaction which otherwise might come, if they build a special machine for killing and then come out and announce that they kill at 1,000 volts. Make

the law state that it shall be 10,000 volts, and then that cannot be trifled with, for no executioner acting under the law would dare to announce that he had fulfilled its mandate in any other way except as provided by the statute; that is what we had in mind, that if we leave this open, that they will construct a machine of such voltage as they choose, and they can come out and strike the very blow from their special machine that they originally meant to strike by securing an ordinary standard commercial machine. With that we are in a position to relieve the electric lighting commercial machine from the odium of furnishing an ordinary instrument of execution for criminals. I hope the section will stand as it has been presented, with the simple amendment, if Mr. Lockwood desires to add it, of a quantity of current that will insure the desired result beyond a question.

MR. DE CAMP: I think Mr. Perry expresses very clearly the sentiments of the whole committee, and the idea that they had in making that report. We cannot alter the law. The committee which has had it in charge find that there is a strong tendency to keep it on the statute book. Electric execution has got to be the law of the State of New York. Ten thousand voltage may be to some scientific people a meaningless expression, but if the State authorities cannot use less than that, the parties who are advocating that are interested in having a sure death. A bungle of an electric execution, or one or two of them, means the repeal of that law, just as sure as we are here to-day. The sentiment worked up on the subject is purely on the ground of the humane method of the execution of criminals. Just as soon as the public see that it is not humane, it is very easy for us, if it is necessary to take any action at all, to have that law repealed. Therefore, I think, if the resolution stands as it is, it will accomplish the object we have in view just as effectually as we can do it in any way.

DR. MASON: I would ask whether after we have put ourselves on record by a resolution passed at New York, and I am not sure but that was repeated, as being in favor of this business, is it necessary that we should eat our words? Can't we work just as strongly without any action on the part of the Association? Do the committee need our action?

THE PRESIDENT: I will say that that matter was presented in strong language to the authorities in the State of New York on former occasions, and my idea in raising this point was that the action of this Association, which is a semi-scientific body, be not unscientific. It seems to me that this section can, by a very simple amendment, be made to meet all the requirements. The committee thought they should receive some support.

MR. PERRY: I think there is something here to guard, and that is the interest of electric lighting throughout this land, and no one can deny that it is important, if it is possible, to draw a broad line between the killing machine and the commercial lighting machine. The committee arrived at this conclusion after a very careful examination, that we cannot stop the action of the law, but the next best thing is to so far relieve commercial apparatus from the odium of being used for that purpose, to draw the line so that while the opponents of high tension are in the ascendency, it shall not appear that they have been killed with a commercial machine or with a commercial potential, a potential used in every-day work. That was the point with the committee; to relieve the commercial apparatus from that odium.

THE PRESIDENT: I wish to say that I visited Mayor Maher, who was the chairman of the committee appointed at our last Convention to present this matter to the Governor of New York, some few months back, with a view of finding out what had been accomplished and what might be done, and he told me that he had seen the Governor, and the Governor had expressed himself very positively as against doing anything in the line of the petition which we had submitted to him. I then suggested to Mr. Maher that in order to relieve the commercial apparatus and avoid any strife between commercial interests, a recommendation be made to the authorities to have special apparatus devised upon the specifications of some eminent scientist, who had no connection whatever with any commercial interest. Mr. Maher said that he thought something could be accomplished in that line, and that he had no doubt that if that line was followed up properly, the result could be accomplished in that way. While I have heard nothing from him on this subject, I understand from the chairman of this committee that this

matter has been followed up and that they have hopes of accomplishing by this means the desired results. I only wanted to have the action of the Convention go out as technically correct.

MR. FRANCISCO: As a member of the committee, I want to say that the committee has spent a great deal of time in the investigation of this subject, they have not gone into it superficially, they have gone thoroughly into the matter and investigated it in all its phases, and after all the investigation they have made and full discussion of the matter, they have decided that that was the best plan that could be adopted, and I hope that the report will be adopted.

The motion of Dr. Mason to adopt the section as read was then put and unanimously carried.

The reading of the report was then continued and upon its conclusion, Mr. De Camp moved the adoption of the recommendation to appoint a committee on revision of the Constitution.

DR. MASON: I move that a committee be appointed upon the revision of the Constitution, the committee to choose its own chairman.

MR. DE CAMP: I move to amend that by adding that the committee also formulate by-laws or rules of government.

Dr. Mason accepted the amendment.

The motion as amended was seconded by Mr. Perry.

THE PRESIDENT: Of what number shall the committee consist?

DR. MASON: Five.

The motion to appoint a committee was then put and carried, after which Mr. De Camp moved the adoption of the report as a whole, which motion was carried and the report was adopted.

Mr. Gerald W. Hart then read the report of the Executive Committee, as follows:

REPORT OF EXECUTIVE COMMITTEE.

The Executive Committee has confined its work largely to the present Convention, other matters connected with the Association having been delegated largely to special committees.

The following committees have made reports at this Convention, and the reports have been accepted and spread upon the Minutes:

Committee on Underground Conduits and Conductors, Mr. E. T. Lynch, Jr., Chairman.

Committee on Harmonizing Electric Light and Insurance Interests, Mr. P. H. Alexander, Chairman.

Committtee to Confer with Mayor Grant in Regard to the International Exposition of 1892, Dr. Otto A. Moses, Chairman.

Committee on Electrical Data, Mr. A. R. Foote, Chairman.

Committee to Memorialize Congress on the Abolition of Custom Duty on Copper, Mr. C. A. Brown, Chairman.

Committee on Standardization of Potential on Electric Street Railways, Mr. E. T. Lynch, Jr., Chairman.

The National Committee on State and Municipal Legislation, Mr. A. R. Foote, Chairman.

The work upon which these committees have been engaged is of great importance to the Association, and the reports show that the subjects entrusted to them have been carefully considered, and a great amount of work accomplished. The Secretary informs us that the number of communications from these committees which have gone out to the electrical public, exceeds 12,000.

The following committees have not reported:

Committee on Patent Legislation, Mr. Arthur Steuart, Chairman.

Committee on Electrical Execution, Mr. E. A. Maher, Chairman.

Owing to the fact that the members of the Executive Committee are so widely separated, but one meeting has been held prior to the present session, since the Niagara Falls Convention, although the members have been in constant communication.

At the above named meeting, held at New York, on October 25, the date of the present Convention was decided upon, and a general programme was outlined; also an important resolution upon the compulsory use of underground systems for high potential circuits was passed.

The finance committee, a sub-committee of the Executive Committee, has audited and approved the accounts of the Treasurer. A committee on credentials has been appointed for the purpose of examining the credentials of the active members.

The finances of the Association have never been in better condition than at present, or the future more promising. The experiment of the past year, of having the headquarters of the Association at New York, has proved to be an entire success.

Since the last Convention, there has been a net gain of 61 members; the total membership being now over 300. At a recent meeting, the following names were unanimously recommended for honorary membership in the Association, agreeable to the constitutional provisions therefor (see article 3, section 4):

Sir William Thomson, Prof. Henry A. Rowland, Chas. F. Bush, Thos. A. Edison, Prof. Elihu Thomson and Frank J. Sprague.

G. W. HART, *Chairman*.

MR. DE CAMP: I move the adoption of the report as read, if

that will cover the suggestion as to the election of honorary members.

THE PRESIDENT: It will. There must be a two-thirds vote on the recommendation of the committee, which is carried with the report.

MR. DE CAMP: Then, if the adoption of the report will cover that point, I move that the report be adopted by a standing vote.

The report was then voted upon by a standing vote and unanimously adopted.

SECRETARY GARRATT: I want to say that there are about 40 members who have not resigned their membership in the Association, and yet do not pay their dues.

AFTERNOON SESSION.

FEBRUARY 14TH.

The meeting was called to order at three o'clock, by President Weeks. Coates' Opera House was filled with members of Kansas City society, who were in attendance to listen to the reproductive voice of the phonograph.

THE PRESIDENT: Before proceeding with the phonogram from Mr. Edison, we will hear from our newly elected President of the National Electric Light Association, Mr. Marsden J. Perry, of Providence, R. I.

Mr. Perry was received with great enthusiasm and addressed the Convention, as follows:

Mr. President, ladies and gentlemen: I am deeply sensible of the honor which you have conferred upon me by electing me as your President. I know at our Convention in Chicago, there seemed to be a critical moment, a year ago, when a strong man, and a true one, was needed for the position of President of this Association, when it came to me on the instant that we had with us at that time the very man; a man of scholarly tastes, exceptional business ability, sound scientific acquirements, and the necessary firmness for an executive officer. His name was Edwin R. Weeks, of Kansas City, Mo. (Applause.) Mr. Weeks accepted the honor—and I assure you that when he did so it took a man of considerable courage—and out of some confusion, has

arisen the present occasion, our next annual Convention, by all means the most successful, the most instructive one that we have ever held. The history of the National Electric Light Association is but five years old, in point of time, but the science and its application commercially is a hundred years in point of advance, as compared with the previous hundred years. We have assembled here to discuss the topics of interest to us. We have now about concluded our labors, and shall return to our toil. I wish to thank you in behalf of the National Electric Light Association for the wealth of hospitalities which we have enjoyed here in your city and at your hands. (Great applause.)

You, sir, Mr. President, have nearly finished your official course, and are about to lay down the duties and the responsibilities—responsibilities, sir, in the acceptance of this office, of which I am not unmindful. But in separating yourself from the office, you leave this Association under a debt of gratitude and obligation that it will take long to repay. You take with you into your unofficial life, a bond of sympathy, a warmth and depth of feeling that will not soon be broken, marred or forgotten.

Gentlemen of the Convention, the grand results which have been achieved from so small a beginning, have not been accomplished by a single hand. It has only been by united effort, and I shall rely on you during the coming year for a strong united effort as well as on your indulgence with me, that we may repeat again, if possible, the glorious record of the past year. Thanking you again for the honor which you have bestowed upon me, I shall take up no more of your time. (Applause.)

THE PRESIDENT: Ladies and gentlemen, we are fortunate in having with us on this occasion one who has been for years intimately connected with Mr. Edison, one whose name has stood for the Edison interests throughout America; one whom I have, on urgent solicitation, succeeded in inducing to address you. I take great pleasure in introducing to you Mr. Edward H. Johnson, of New York City,

Mr. Johnson then addressed the Convention, as follows:

Mr. Chairman, delegates of the Convention, ladies and gentlemen: President Weeks has sufficiently apologized for my appearance before you, to speak upon a matter that comes in the

nature of a surprise to me, and he has also explained why I am called upon to speak concerning Mr. Edison's phonograph. Having been associated with Mr. Edison, in the laboratory and out of it, almost constantly now for the past 20 years, I am necessarily more or less familiar with everything that he has done. The phonograph, however, is an invention with which I am particularly familiar. Therefore, it would seem appropriate that I should comply with the request of your Chairman and say a few words to you on that subject. At first, he only called upon me to explain the operation of the instrument, the principle upon which it acts, and to that I assented. Then he broadened out his request until, finally, he wishes me to go at some length into the history of the instrument and the whole subject. To do Mr. Edison justice, and to do myself justice, I could not well do that. I have agreed, therefore, simply to relate the circumstances under which the phonograph had its origin, then explain the instrument to you, and then call upon the gentlemen who have the device in charge to operate it for your benefit.

When Professor Bell brought out the magneto telephone with which you are not only familiar, but which your children now know, Mr. Edison conceived the idea of amplifying the voice of the telephone, so to speak, by producing a transmitting apparatus which would generate a much stronger current than Mr. Bell's instrument did; and thus, by operating upon Mr. Bell's instrument as a receiver, produce a much more audible and distinct vocalization, and render the instrument of much wider commercial value. It was in the course of these experiments, which ultimately led to the carbon telephone transmitter, now universally used throughout the world, and which you all recognize as the instrument to which you address yourselves when you are speaking in the telephone; and it was in the course of his experiments with that instrument that he conceived the idea of the phonograph. It did not dawn upon his mind, or for that matter, upon the mind of any of us associated with him at the time, just what he had done, *i. e.*, produced a talking machine. He remarked to me one evening, when he was pressing his finger lightly against the diaphragm of a telephonic instrument, and feeling these vibrations, "Johnson, if I was to put a needle in the center of that diaphragm and make a point there, an indenting

point, like the point on the old time Morse telegraph register" —with which you are no doubt familiar—"then draw a slip of paper, or other easily impressed substance, underneath that needle, the vibrations of that diaphragm would be accurately recorded on that paper." Being an old telegraph operator myself, I immediately saw the force of that apparently not very sage remark, and I said, "Certainly, it will, but what of that?" "Well," he said, "If we take that paper and start afresh with it, and draw it under the point of that needle, put a slight tension on the needle and pull the paper, it will follow the ins and outs of these indentations that naturally would be in the paper, precisely as it did move when it made the original indentations." I said, "That is true; but what of that?" "Well, only this; that would be a telephone repeater. Of course, if I speak in the telephone, and that produces a vibration on the receiving telephone's diaphragm, that receiving instrument is made to record these indentations on that piece of paper, and that paper is afterwards drawn under that needle, that diaphragm re-vibrated, without the action of the human voice, I have only to make that second diaphragm another transmitter, and I will carry my message on again to another station. Thus, instead of telephoning within the limit of the capacity of a single instrument, I will telephone to those limits, and then automatically repeat the speech over another circuit to the limits of the second circuit. In other words, you will make a telephone repeater that will be the exact counterpart of the telegraphic repeater so well known in general use." I said: "It looks feasible; it looks practicable." That was the end of it for the time being. Neither one of us, or Mr. Batcheller, or the other laboratory associates of Mr. Edison, thought any more about it for a long time. I was in somewhat straitened circumstances at the time, as we all were, owing to the fact that we had spent some six years in developing a system of electric automatic telegraph which we sold to our friend, Mr. Gould, who was several years paying for it, and has not yet settled up entirely. The situation was that we had to look around and see what we could do to earn our bread and butter. Mr. Edison has since found a way of earning his. I had to strike out in some new direction, and it occurred to me that it would

be a very good idea to go around to the leading watering places —this being Summer time—and exhibit Edison's telephone and apparatus, particularly the musical telephone that he had, describe it to the public and those who seemed to be very much interested in these acoustic experiments of Mr. Edison and Mr. Bell, at that time, and make a little money that way. I did it by having my singers stationed in the Western Union Telegraph Building, in New York, having my receiving apparatus in a house like this at Saratoga, Buffalo or Rochester, 400 or 500 miles distant from New York, and reproducing the voices of these singers to my audience at these distant points. It was very successful. A great interest was being aroused in the subject just at that time. In the course of one of my lectures or improvised talks, it occurred to me it would be a good idea to tell my audience about Edison's telephone repeater, at Buffalo, which I did. My audience seemed to have a much clearer appreciation of the value of the invention than we had ourselves. They gave me such a cheer as I have seldom heard. I did not comprehend the importance of the device at that time; but the next morning the Buffalo papers announced in glaring headlines: "A Great Discovery! A Talking Machine by Professor Edison. Mr. Edison's Wonderful Instrument will Produce Articulate Speech with all the Perfections of the Human Voice." I realized, for the first time, that Edison had, as a matter of fact, invented a talking machine. The immediate importance to me was that this created a sensation, and I had very large audiences in all my entertainments thereafter. Realizing that, and having had sufficient experience by this time to profit by such things, I made a special point of this feature in my next entertainment, which was at Rochester, and I had a crowded house—one that did my heart good, and my pocket, too. There was a most magnificent enthusiasm. That satisfied me that I had better go home and assist in preparing this instrument. I knew from my own experience in the matter that it was a comparatively simple thing to do, so I cancelled 13 engagements ahead and went back home with these newspaper clippings. I went straight down to the laboratory, which was then at Newark, and I said, "Mr. Edison, look here. See the trouble you have got me into." He read these things over and said, "That is so; they are right. That is what it is, a talking

machine." I says, "Can you make it?" He says, "Of course. Have you got any money?" I says, "Yes, I have a little," and I had—a little. He says, "Go to New York and get me three feet of stub steel an inch and a half in diameter, and get me a piece of brass pipe four inches in diameter and six or eight inches long and bring it down here and we will make it." I took the next train to New York and got the material, took it back and went to work. Within 24 hours, we had a little revolving cylinder turned with a crank and a simple diaphragm needle, which I will explain presently; wrapped a sheet of tinfoil around the cylinder, and gave it the original phonographic sentence, "Mary had a Little Lamb." Then we set it back to see what the instrument was going to do about it. It came out to our entire satisfaction. Not as clear as it does to-day, but it was "Mary had a Little Lamb" sure enough. That was the original phonograph and the starting point of an invention, which, notwithstanding all that Mr. Edison has done since, notwithstanding my high appreciation of what he has accomplished, notwithstanding the commercial value, the vastly greater relative commercial value of his subsequent inventions, is to my mind the greatest thing he ever did, and which, as a matter of fact, is the invention which has carried Mr. Edison's fame and name, outside of the comparatively limited technical circle in which he was then known, throughout the civilized world (great applause), and makes to-day the simple announcement that somebody, it makes no difference who he may be, known or unknown, is going to make a few remarks about Edison quite sufficient to crowd the largest auditorium with the most intelligent members of any community, in this country or abroad. And I speak from experience when I make that statement.

Now, a few words in explanation of this instrument, and then you shall hear it. In the first place, there is a mistaken idea as to the character of the instrument. It is popularly supposed to be an electrical instrument, because it is the invention of the greatest of all electrical inventors. It is not an electrical instrument at all. It is a mere bit of mechanism. It is a mechanical arrangement pure and simple. It is necessary to have a revolution of the cylinder, and to get that mechanical motion you

must have some motive power. As I explained, the original machine was turned by hand. Others have been turned by water motors, gas motors. This instrument on the platform, I see, by the electric cords, is operated from an electric motor. That is a matter which has no significance in relation to the machine, it is merely the motive power to turn the instrument and is no part of it. The instrument is simply mechanical. Its principle is this: When I speak I throw the air into vibration of a given form. That strikes upon the ear and produces, on the auditory nerve, certain sounds, or rather they convey to the brain certain sounds, that is, what we term sounds. Those sounds are infinite in variety, but they have an intelligent meaning to the brain, that meaning being simply a matter of education. It follows, therefore, that if I can produce these vibrations on the air, by other than my own voice, but precisely and identically those vibrations, I will produce upon the ear and consequently upon the brain precisely the same sensations and they cannot mean anything else in the one instance than in the other. Therefore, this invention is nothing more or less than an instrument which will accurately receive and record those vibrations and retain their character, form and number, with absolute precision, and then mechanically do the work by operating something which will contribute again to the air all those peculiar waves of the vocal cords of precisely the character and form of the vibrations that it originally received. If it can be done, you will, of course, at once perceive that the instrument, although a bit of mechanism, if it has the capacity to reproduce those vibrations, it necessarily has the capacity to produce upon the brain precisely the same sound that the vocal cords produced in the first instance. Therefore, what we want is an instrument that will do that. Now, let us see how we make an instrument of that kind. You take anything, no matter what, a piece of paper like this (indicating), and utter a sound the musical note "do," for instance, and in touching it with your finger on the opposite side you feel the vibration. Very well, we will call that the diaphragm, a paper diaphragm. We will put that in a suitable frame, and hold it in such a position as we want to. Then we will attach to the center of that diaphragm, because the center is the point of the greatest amplitude and the greatest vibration, necessarily, that needle. Not

a sharp pointed needle, but a needle whose point is comparatively sharp, one that will not scratch, but will simply produce the indentations upon that yielding substance. Take and arrange that in such a way that this diaphragm has this needle point against the surface of the revolving cylinder. Now, we will put around the revolving cylinder that substance—paper is a little too hard for the needle to indent, of course; but tinfoil, which is much better, and it was, therefore, used for a long while, so we will say tinfoil for the time being. We will put around that cylinder a sheet of tinfoil, and we will adjust this instrument so this needle will press slightly against that tinfoil. Now, we will revolve the cylinder with a screw attachment at the end, so that the cylinder shall go past, transversely, in front of this needle, very gradually, so as to present a constantly new surface of tinfoil to the needle. Now, you speak against that diaphragm and cause a vibration of this needle, while that tinfoil is passing in front of it, and you will necessarily produce on that tinfoil indentations of precisely the same number, and of a depth corresponding to the amplitude of vibration of the diaphragm. Precisely the same as the diaphragm yields, and that will yield precisely the same as the air yields that has been put in motion by the voice. Consequently, you have an absolute record on the tinfoil, of the vibrations of the air, effected by the vocal cord, not only in number, but of the same character in all other particulars. Now, if you will reverse this action, this cylinder, send it back again, turn it backwards, if you please, then drag the needle back again, on to these indentations, precisely where they began, and do nothing but simply rotate that cylinder so as to cause the needle to traverse the ground over again, thus going in and out of all the little indentations, you get precisely the same effect upon the diaphragm as you had originally, because, it now being moved by the rough path, so to speak, which it previously created, it must necessarily follow the same ups and downs. So that you get the diaphragm in motion again as it was before, with the net result that the diaphragm contributes to the air precisely the same movement that the air had sent out from the diaphragm. Consequently, you get perfectly articulated speech. That is all there is to the instrument. This instrument lay dormant for about 12 years. Mr. Edison went from his telephonic

experiments immediately into his electric light experiments, and, consequently, gave no attention to the phonograph, always saying to those of us who would urge him to take the matter up: "When I get through with this, I will take that up. That shall be the next thing." But the electric light came along, and before he got through the carbon transmitter he took that up, and the phonograph was ignored. Then he promised to take it up when the electric light matter was settled. Before he had satisfied himself with his work in that direction, others took up the phonograph, and worked on it to considerable purpose, namely, Messrs. Taintor & Bell—Professor Bell, of telephonic fame. He and his associates took the matter up and endeavored to make a phonograph which was then merely a scientific novelty. In other words, to do for Edison's phonograph, what Edison done for Bell's telephone, make it a commercial as well as a scientific success. They succeeded in developing what has proven to be the correct principle; namely, that instead of making indentations in this plastic substance — wax, which is now the thing used — they made a little cutting knife, and actually cut the material out with each vibration, thus effecting two things, a more decided record than was made by the indentation method.

The result of that was an instrument which while it did not speak and was not intended to speak in the original voice, as the old tinfoil phonograph did, yet it spoke with such distinctness that if you placed the tubes to your ear, while the voice was low, it was wonderfully clear and the utterance was easily comprehended. They brought out on the basis of that improvement what is now universally known as the graphophone, which is simply the phonograph turned the other way around. They did not claim to have anticipated Mr. Edison in this great discovery. They simply claimed to have perfected Mr. Edison's instrument and thus brought it into the realm of commercial utility; but they did not make the progress that they expected, and Mr. Edison then took the subject up again, and the result of his efforts in that direction was the perfected phonograph. Consequently, we now have the graphophone and the phonograph.

A very shrewd gentleman in New York, recognizing the great

possibilities of this thing, went to work to acquire the ownership of both. Consequently, the North American Phonograph Company, to-day, is the owner of all the rights of the graphophone and the phonograph, and now being but one common instrument, the aim in this instrument is to give you all that is known of the last and best development of this wonderful apparatus which is to record what we say, keep it for any length of time, and then reproduce it for any purpose we may wish, with as perfect a retention of the character and quality of the original voice as the telephone, to-day, in its best form. We will now endeavor to hear the instrument. (Applause.) I want to say that this instrument, although it is fitted up here with a rather elaborate contrivance so that you may hear it, is designed expressly not to do that which we are going to call upon it now to do; namely, to talk loud. It is designed to address itself to the individual ear. That is because the instrument is intended for commercial use, and we do not want the message or letter, which I have dictated in my study at home and sent to the office to have the typewriter put it in type, to be heard by everybody in the room. Consequently, the instrument is designed to speak in a low, clear tone to the ear. We can make them speak as loud as we please, but at some loss of clearness of articulation. Inasmuch as it is impossible for everybody to assemble around the instrument closely, we will endeavor to make the instrument speak loud enough for you all to hear.

THE CHAIR: Having been favored with these pleasant personal reminiscences of the early work of the invention of the phonograph, by Mr. Johnson, we will now hear the instrument itself.

First, we will have from it a cornet solo by Levy.

MR. JOHNSON: In that connection I will say that Mr. Levy played in that instrument many years ago and frequently since, and invariably took pains to inform the audience that the phonograph was his only competitor on the cornet. (Laughter and applause.)

The phonograph was then brought into action, and after reproducing several cornet solos by Levy, that of "The Brave Swiss Boy" being specially applauded by the audience, it delivered the following message from Mr. Edison:

FROM THE LABORATORY OF THOMAS A. EDISON.

ORANGE, N. J., Feb. 7, 1890.

EDWIN R. WEEKS, ESQ., Kansas City, Mo.:

MY DEAR MR. WEEKS:

When I had the pleasure of meeting you at my laboratory, in December last, you suggested that I should send to the Kansas City Convention, which commences next week, a phonograph discussion upon the subject of my five wire system of distribution, which you were good enough to assure me would prove of interest to the delegates, and ever since that time I have been trying to find an opportunity to prepare the data.

My failure to do so has been through no fault of yours, as your letters have constantly kept the matter before me, nor has it been through want of inclination on my part that I am obliged to substitute this explanation.

Certain urgent matters of business which I was unable to anticipate have occupied my attention to such an extent that I have even had to neglect the important work of my experiments.

While I could not have contributed to the success of the Convention, which is already assured through its location in your enterprising city, I regret that I am unable to send something which would at least be more interesting than this apology.

Yours very truly,

THOS. A. EDISON.

After Mr. Edison's message had been uproariously acknowledged by the audience, the phonograph was persuaded to furnish a xylophone solo with a piano accompaniment, which received an enthusiastic reception.

The business of the Convention was then taken up, and the following was offered by Mr. De Camp:

Whereas, More than $100,000,000 have been invested in central electric light companies in America, and

Whereas, The stocks and bonds of these companies have been and are being depreciated and jeopardized by a reckless and disastrous competition, encouraged and fostered, to a large extent, by rival parent companies; and

Whereas, This course of conduct threatens the destruction alike of central station companies and of parent companies, the profitable continuance of whose business depends upon the healthy life of the central station companies; therefore,

Resolved, That The National Electric Light Association appoint a committee of seven, whose duties shall be to devise and execute plans for the ceasing of the evils referred to.

Resolved, That the President appoint this committee, and that any vacancies occurring be filled by the incoming President.

The resolutions were heartily supported by Mr. Mason, of

Boston ; Mr. Armstrong, of Camden ; Mr. Lockwood, of Detroit, and Mr. Francisco, of Rutland, Vt., and were unanimously adopted.

The Chair announced the appointment of the following committees ;

ON UNDERGROUND CONDUITS AND CONDUCTORS.

J. E. Lockwood, of Detroit, C. H. Wilmerding, of Chicago,
Schuyler Wheeler, of New York, T. C. Smith, of Philadelphia,
David E. Evans, of Baltimore.

ON REVISING CONSTITUTION AND BY-LAWS.

Dr. A. F. Mason, of Boston, A. J. De Camp, of Philadelphia,
E. A. Armstrong, of New Jersey, M. J. Francisco, of Rutland, Vt.,
E. R. Weeks, of Kansas City, Mo.

ON RELATIONS BETWEEN PARENT AND SUB-COMPANIES.

Marsden J. Perry, of Providence, R. I., Chairman.,
Mr. J. F. Morrison, of Baltimore, J. E. Lockwood, of Detroit,
Mr. F. A. Gilbert, of Boston, E. A. Armstrong, of Camden, N. J.
E. R. Weeks, of Kansas City, Mo.

Mr. Cutter George, of Chicago, presented the following resolutions, which were unanimously adopted:

Whereas, It seems desirable that underwriters' rules, governing the installation of electrical apparatus for light and power, should be the same throughout the country, and that they should be as plain and concise as would be consistent with their efficiency, and

Whereas, In order to secure the formulation and adoption of such rules, it seems necessary that the authority be vested in a committee composed of representatives of all parties interested; therefore, be it

Resolved, That the Chair select and appoint a committee of five members of The National Electric Light Association, who shall have power to choose three representative electrical men to act on a committee for the purpose of devising and adopting national insurance rules and considering any other matters affecting the joint interests of insurance and electrical companies ; and be it further

Resolved, That the committee of five be requested and authorized to negotiate with the various general insurance organizations throughout the country, with a view to securing the appointment by them of representatives on a national electric insurance committee, and that the committee of five report the result of its deliberations and actions at the next meeting of this Association.

DR. MASON (of Boston): I wish to introduce the customary

resolution, which if ever offered would be most fitting on this occasion. I move that The National Electric Light Association express to the people of Kansas City, generally, to the railroads, the surface roads, the local reception committee, the transportation committee and all others who have extended us special courtesies, our heartfelt thanks, as an evidence of our appreciation of all their generous treatment. I might add very much more, but no words that I could use would more clearly express my deep sense of appreciation of their kindness.

The resolution of thanks was adopted unanimously by a rising vote.

Secretary Garratt announced the reception of a letter from the Chairman of the Trustees of Guthrie, Oklahoma, inviting the Association to visit that city.

Dr. Mason moved that the Association instruct Secretary Garratt, if possible, to visit Guthrie, and express to the citizens of that city, the good will of the Association, taking with him any members who wished to accompany him.

Dr. Mason's motion prevailed.

SECRETARY GARRATT: I have one other letter in reference to which I came very near violating my duties as Secretary, which require me to bring all matters before the Convention. I am quite impressed by the effect The National Electric Light Association has produced upon the western people, as appears by a letter addressed to the Association by a lady; the letter informs me that she is an eminently respectable person, a minister's wife, and she encloses a dollar and a half, and wants us to forward to her a pair of electrical corsets. (Laughter and applause.)

Dr. Mason moved that the Secretary be instructed to grant the lady's request.

The motion was carried by a unanimous vote, amid much laughter and applause.

Closing the Convention, Chairman Weeks said: "As we have finished our business, I now declare this Convention adjourned."

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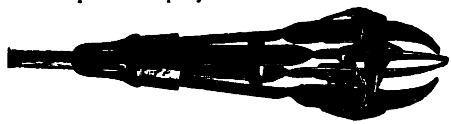

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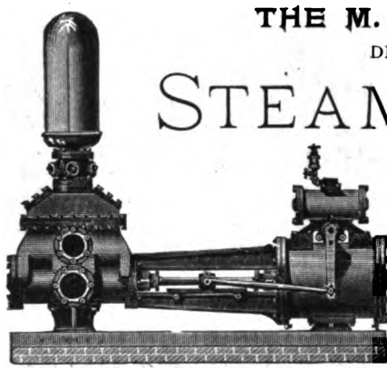

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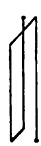

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